

ARCHIVES OF OTOLOGY.

ON THE VALUE OF OPERATIONS IN WHICH THE MEMBRANA TYMPANI IS INCISED.*

By D. B. ST. JOHN ROOSA, M.D.

ONE of the subjects that will be discussed at the coming meeting of the International Medical Congress in London, is that which I have taken as a title for this paper. On receiving the announcement it occurred to me that if the time and your convenience allowed, it would be proper for our Society to join in this discussion, and present to the profession our opinion as to the value of operations upon the drum-head.

We are all familiar with the early history of an operation which was first undertaken by Cheselden on the brute species, and continued successfully on the human subject by Sir Astley Cooper. We have all joined in the trial of attempts by galvano-cautery, eyelets, myringectomy, and acids, to maintain permanent openings in the membrane. We have also tested division of the tensor tympani, simple incisions followed by injections, excision of the malleus, repeated paracentesis, and, finally, we are all in the habit, as occasion may require, of evacuating mucus, blood, and pus by incision in subacute, and chronic cases.

But what has been the outcome of all this history? In what cases do we *now* recommend and perform operations that involve an incision of the membrana tympani? I am sure that the profession at large, both in this country and abroad, would consider our testimony on this subject of some value, for nowhere in the world is otology cultivated with

* Read before the American Otological Society, July, 1881.

more zeal, and, as it seems to me, with more knowledge, judgment, and skill than on this side of the Atlantic. I know of no way of getting at this discussion, if the Society feels disposed to enter upon it, than for each member to frankly state in what cases he at the present time is in the habit of incising the membrane, and also to give the reasons why he rejects other procedures than those which he adopts.

As for myself, I will say that I have given up all operations in cases of chronic proliferous inflammations, or, if you prefer the term, in chronic non-suppurative cases where there are perhaps adhesions between the ossicles, or between an ossicle and the promontory, and where there is no suspicion of retained mucus in the tympanic cavity.

I have finally rejected operations in these cases, because some experience of my own, in the way of division of the tensor tympani, insertion of an eyelet, attempt at maintenance of a permanent opening by means of incisions and frequent paracenteses, has convinced me that these operations are inadequate to relieve tinnitus aurium, improve the hearing, or retard the advance of a disease which as yet must be pronounced as hopelessly incurable as chronic non-inflammatory glaucoma, or atrophy of the optic nerves.

The experience of others, of whom I may mention Weber-Liel, Hackley, Simrock, Pomeroy, Hinton, Prout, some of whose cases I have been permitted to study as if they were my own, has only strengthened me in my conviction, that we are as yet without any operation which can rescue these cases from the awful category in which they, as it seems to me, have been placed.

When we enter the field of accumulations of mucus or pus in the tympanic cavity, cases that may be plainly made out by all of us, in most cases without a reasonable doubt, we have entered into a hopeful arena. Here paracentesis, *carefully performed*, and for the most part by far in acute or subacute cases, is, I think, a great addition to our means of cure. I do not, however, incise every bulging drum-head. I still regard paracentesis of the membrana tympani as an operation not to be lightly undertaken, and always to be

performed with gentleness. Necessary as may be the evacuation of mucus, it may often be removed, even with a little delay, by a thorough employment of Politzer's method of inflation, and by attention to the throat and nostrils, and an operation by incision be avoided. Red as may be a drum-head, swelled as it may be from vascularity, a proper employment of leeches will also often serve instead of a cutting operation upon the membrana tympani.

Scarification of the membrana tympani (Blake), may sometimes be advantageously substituted for incision in cases of vascular and slightly bulging drum-heads.

In performing the operation of incision or paracentesis, I am greatly in favor of what may be called the gentle method.

1. I use a small needle.
2. The incision is made just large enough to give exit to the pus, blood, or mucus.

Important as may be an early, free, and deep incision in paronychia, incisions in the membrana tympani are sometimes too early, because a little delay would render them unnecessary. They are sometimes too free, because they are longer than is necessary to evacuate the fluid contents of the tympanum; and too deep, because they injure the walls of a chamber which it is dangerous to unduly harm. It should be remembered, I think, that the term "a free incision," so cardinal a point in surgery, is, after all, only relative. What would be a free incision in a finger becomes excessively large in a drum-head.

EXPERIMENTAL INVESTIGATIONS AS TO THE
INFLUENCE OF THE NERVES OF THE DRUM
CAVITY UPON THE VASCULARIZATION AND SE-
CRETION OF ITS MUCOUS MEMBRANE.

By E. BERTHOLD, OF KÖNIGSBERG.

Translated by ISIDOR FURST, of New York.

IT is well known that in the innervation of the drum cavity, besides the sensitive fibres of the trigeminus, the sympathetic and the glosso-pharyngeus nerves likewise participate. Not so well known is the physiological importance of these nerves for the middle ear. From an article by Hagen,¹ I first learned that, according to a communication read by Gellé² before the Société de Biologie, on December 8th, a distinct vascularization in the mucous membrane of the drum cavity occurs after lesions inflicted upon the medulla oblongata of dogs and rabbits. Hagen, who has tested Gellé's statements, after intercranial divisions of the trigeminus, decides that Gellé's conclusions must be rejected, *i. e.*, that the division of the trigeminus exerts no influence upon the vascularization of the mucous membrane of the drum cavity. On the strength of these contradictory statements by Gellé and Hagen, I thought the question needed renewed investigation, and I undertook the task all the more willingly, because I dared to hope that its answer would at the same time bring nearer to a solution

¹ Hagen: Ueber das Verhalten der Schleimhaut der Paukenhöhle nach Durchschneidung des Nerv. trigeminus in der Schädelhöhle. *Archiv für experimentelle Pathologie und Pharmacologie*.

² Gellé: Lésion de la muqueuse auriculaire à la suite des lésions bulbaires. *Gaz. méd. de Paris*, 1878, No. 1.

the question as to the existence and the quality of the so-called trophic nerves. However, for the purpose of verification, it seemed to me desirable not to restrict the experiments to the trigeminus, but to extend them also to the other two nerves supplying the drum cavity—the sympathetic and the glosso-pharyngeus. Accordingly, the investigation resolved itself into the following series of experiments:

1. Intracranial division of the trigeminus.
2. Semi-lateral division of the medulla oblongata, in order to destroy the roots of the trigeminus.
3. Extirpation of the supreme cervical ganglion of the sympathetic.
4. Tearing out of the glosso-pharyngeal nerve.

Of course, after the death of the animal, every operation was followed by the examination of the mucous membrane and the contents of the bulla ossea of the test animal. The rabbit was the only animal used as such. All the experiments were made in the medico-physical institute of my esteemed friend and colleague, Professor Grünhagen, and the majority with his assistance. We have used considerably more than one hundred rabbits in the investigation. The neurotome which we employed for the intracranial division of the trigeminus was a small knife with a slightly convex edge. The knife itself was adjustable in a sheath. Before the operation, the length of the knife was measured off on a macerated skull which was approximately of the same size as that of the test animal. It could not be projected any farther than the commencement of the sheath, and thus too deep an introduction of the neurotome was avoided. The knife was introduced according to Bernhard's direction. The object of our operation was always the division of the trigeminus immediately in front of Gasser's ganglion, *i. e.*, where the trigeminus emerges from this ganglion. The accidents during the operation I may assume as well known. They cannot always be avoided even by the most expert, because the forms of the skulls of the rabbits employed for the operation often vary greatly. With some practice, constant results are soon secured.

The division was looked upon as successful when the usual symptoms appeared—the screaming of the rabbit as soon as the first branch of the trigeminus was struck; the contraction of the pupil, which again disappears after a while; the anæsthesia of the cornea and conjunctiva of the respective side; finally, the anæsthesia of the Schneiderian membrane and of the upper lip. Even if all these symptoms were developed during life, the animals were still carefully dissected after death, and the three branches of the trigeminus minutely examined both macroscopically and microscopically, from the points of division toward the periphery. Only when a branch could be shown to be degenerated, we considered its division as successful. The division of the first branch was performed only because it gave us the most certain information, by the cry of the animal, whether the knife had been correctly inserted in the act of operation. After some practice in the technique of the operation had been acquired, we spared the first branch of the trigeminus as much as possible, and contented ourselves with scratching it, and causing the animal to scream.

Of the many experiments performed, only those shall be mentioned which justify us in drawing conclusions in regard to the question at issue.

First experiment, January 21, 1880.—Gray, medium-sized rabbit. Left intracranial division of the trigeminus. The animal screams loudly. The pupil becomes narrow, the sensibility of the conjunctiva and cornea of the left eye appears slightly reduced. After the withdrawal of the neurotome a profuse hemorrhage ensues. The left eye projects strongly. The nictitating membrane is in almost its full extent drawn over the cornea. After the lapse of half an hour the sensibility of the cornea has completely returned, and seems to be even increased in the lids.

January 26, 1880.—The sensibility of the cornea is normal, the globe projects considerably, the nictitating membrane is drawn up. At the lower margin of the cornea is a broad, flat ulcer. The eyelids are sewn together to protect the eye.

On *January 28th*, the condition is the same as on the 26th. When the exposed sympathetic nerves are irritated by the interrupted current, the pupils of both eyes dilate equally distinctly.

The nictitating membrane is withdrawn more slowly from the left eye than from the right, probably on account of the protrusion of the globe, for simple mechanical reasons. The animal is now killed by a stab into the nucha.

The dissection discloses partial division of the ramus ophthalmicus, and complete severance of the other two branches of the trigeminus. In consonance therewith, the microscopical examination of the peripheral termini of the second and third branches shows complete, that of the first, only partial fatty degeneration. In the orbit was found a plexus of greatly dilated veins, which caused the protrusion of the eye. The cavernous sinus is probably compressed during the operation, thus interfering with the return flow from the orbital veins. The left bulla ossea was taken out and the mucous membrane viewed with the ophthalmoscope. It was bright-red, as if covered with a thin layer of coagulated blood. No fluid blood was present in the drum cavity. The mucous membrane of the bulla ossea of the side not operated on was normal.

Second experiment, January 21, 1880.—Medium-sized black rabbit. Left intracranial division. No hemorrhage. Complete anæsthesia of the cornea. Contraction, later dilatation, of the pupil. The eyelids were sewn together. The animal is relatively active.

The anæsthesia of the cornea remains constant until the death of the animal, February 2d, A.M. Dissection on the afternoon of the same day. All the three branches of the trigeminus are divided, only a few fibres of the ophthalmicus have been left untouched. The peripheral termini of the second and third branches are completely degenerated; those of the ramus ophthalmicus only partially so. The bulla ossea of the left side is filled with a clear light-yellow fluid, amounting to over 0.1 ccm. In order to measure these minute quantities of fluid, a special apparatus had to be employed. Such an one was found in the capillary pipette of the hæmatimeter devised by Hayem and Nacet, used for the counting of the blood corpuscles. When the fluid is sucked up in portions by this instrument, it is easy to determine small amounts quantitatively up to 2 ccm. A turbid substance was suspended in this yellow fluid. The microscopical examination of the liquid shows sparse, globularly expanded vibratile cells, and coarsely granulated cells, which probably were only more fully altered vibratile cells. They floated mostly aggregated into balls in the field of the microscope.

Third experiment, January 27, 1880.—A medium-sized gray rabbit is operated upon. The anæsthesia of the cornea on the operated left side subsides quickly. The cornea remains transparent.

Fourth experiment.—The same rabbit is operated upon on the right side, on January 30th. Anæsthesia of the cornea is complete. Suture through the margins of the lids; nevertheless, the cornea becomes opacified. The animal dies on the morning of February 3d. Dissection on the afternoon of the following day. On the left side the ramus ophthalmicus was only cut into, but the other two branches were completely severed. The microscopical examination, therefore, exhibited only fatty degeneration of a small number of fibres of the first branch, but complete fatty degeneration of the other two branches. On the right side all the three branches are completely severed, the ramus ophthalmicus so close to the ganglion of Gasser that some ganglion cells are still to be seen on the peripheral end of the first branch. Accordingly, the fatty degeneration of the first branch is only partial. The other two branches are completely degenerated, although but three and a half days have elapsed from the second operation to the death of the animal.

The examination of the two bullæ is made by Grünhagen alone. The left bulla is filled with a fluid in which no fibrin is precipitated. The fluid in the right bulla, however, contains threads of fibrin.

Fifth experiment, January 21, 1880.—Left intracranial division. The anæsthesia of the cornea lasts but one hour.

Sixth experiment, January 27, 1880.—Right division by Grünhagen on the same animal. After the withdrawal of the neurotome, slight arterial hemorrhage. The animal is firmly placed near a moderately warm stove so that it can perform no rolling motion. The cornea of the right eye is quite insensible. Both eyes project somewhat; the nictitating membrane is drawn before both eyes. The palpebral fissure of the right eye is closed by a suture; the cornea in the next few days is still opaque and infiltrated. Death on the morning of February 4th. Dissection on the afternoon of the same day. On the left side the first branch is only cut into, the second branch is completely, and the third incompletely divided. The eye is clear, the drum cavity free from fluid. On the right side all the three branches are found severed, cornea opaque, drum cavity likewise empty.

Seventh experiment, Jan. 23, 1880.—Left division. The cornea soon after the operation is again sensitive.

Eighth experiment, Jan. 30, 1880.—Right division. Anæsthesia of the cornea, of the nasal mucous membrane, of the facial bristles. The jaw is drawn toward the left side. Death on Feb. 4th, 10 A.M., dissection on the evening of the same day. Left side : first branch uninjured, second and third branches divided, bulla empty. Right side : first and second branches divided, third branch not severed. Nevertheless, a blackish-red bloody coagulum is found in the drum cavity.

Ninth experiment, Jan. 27, 1880.—A white rabbit is operated by Grünhagen upon the left side. The cornea remains sensitive ; the animal is lively.

Tenth experiment, Jan. 30, 1880.—The right division is executed on the same animal by myself. The cornea has remained sensitive. Death on Feb. 6th, P.M. Left side : first and second branches normal, third branch degenerated. Right side : the first branch is but partially degenerated, the second not at all, the third completely degenerated. Both bullæ contain no fluid.

Eleventh experiment, Jan. 26, 1880.—Left division. Cornea anæsthetized, becomes opaque soon after the operation, and clears gradually. Death, Feb. 6th, A.M. First branch partly, second and third branches completely degenerated. Bulla empty.

Twelfth experiment, Feb. 11, 1880.—Left division. The sensibility returns one hour after the operation. Death on Feb. 18th, P.M. Dissection one hour later. First branch of the trigeminus only cut into, second and third branches completely divided and degenerated. The bulla ossea is broken on removal, by carelessness with the needle scissors. It is filled with coagulated blood. The bulla on the uninjured right side is normal.

Thirteenth experiment, Feb. 11, 1880.—Left division. Anæsthesia of the cornea and of the nasal mucous membrane. The cornea is purulent. Death during the night between February 22d and 23d. Dissection on the afternoon of February 23d. All the three branches are completely severed and degenerated. Left bulla completely filled with pus. Mucosa thickened and discolored. Right bulla normal.

Fourteenth experiment, Feb. 11, 1880.—Intracranial left division of the trigeminus with the desired result. Anæsthesia of the cornea, etc. Killed on Feb. 23d, P.M., with chloroform. Dissection immediately afterward. The cornea shows an opaque cen-

tral infiltration. Complete severance and degeneration of the three branches. Upon the right side of the brain was found a coagulum of blood at the convexity. Left bulla full of pus, right bulla normal.

Fifteenth experiment, Feb. 16, 1880.—Left intracranial division of the trigeminus with the desired result. Death on Feb. 23d, by chloroform. Dissection immediately afterward. All three branches completely severed and degenerated. The bulla of the left side contains a slight red secretion and a great number of little air-bubbles (foamy secretion). The bulla of the right side is normal.

Sixteenth experiment, Feb. 16, 1880.—Left intracranial division of the trigeminus. The sensibility of the cornea soon returns.

Seventeenth experiment, Feb. 24, 1880.—On the same rabbit the right-sided division of the trigeminus is performed. Death on March 1st, A.M. Dissection on the afternoon of the same day. Left side: first branch partly, second and third branches completely severed and degenerated. The bulla quite filled with white, thick pus. Right: all three branches incompletely degenerated. Cornea totally purulent. Bulla one third full of bloody, semi-solid contents.

Eighteenth experiment, Feb. 24, 1880.—Left intracranial division of the trigeminus. Anæsthesia, later ulceration of the cornea. Death on March 5th by chloroform, dissection immediately afterward. First branch of the trigeminus partly, second and third branches completely degenerated. The left bulla filled with rather thick pus which adheres firmly to the walls and does not flow out. Right bulla normal. Mucosa of the left bulla thickened, gray, discolored.

Nineteenth experiment, Feb. 24, 1880.—Intracranial division of the trigeminus on the left side. The sensibility of the cornea returns after twenty-four hours. Death on March 5th, by chloroform. Second and third branches completely degenerated, first branch but little injured. Left bulla filled with a purulent fluid. Mucosa of the bulla gray, discolored, thickened.

One of these nineteen cases must be left out of the calculation. In it a small black blood-coagulum was found in the bulla, although the third branch of the trigeminus had been missed; probably this coagulum has an origin which stands in no relation to our question. Of the remaining 18 cases,

in 6 no exudation, and in 12 a partly serous, partly bloody, partly purulent exudation was found in the bulla; and in the latter 8 cases, in which the intended section always extended in the same manner, the result was likewise almost exactly equal, the bulla of the respective side being uniformly filled with exudation, mostly thick pus.

Turning now to the *second* series of experiments, in which the roots of the trigeminus were severed in the medulla oblongata, the contraction of the pupil of the eye on the respective side was again looked upon as the sign that the operation had succeeded. Nevertheless, after the death of the test animal, a careful examination of the severed portion was made each time. A chisel-shaped knife devised by Grünhagen was employed as neurotome, which was adjustable with another pointed double-edged knife in such a manner that the surfaces of both blades together formed a right angle. After exposing the posterior obturator membrane, the pointed knife was inserted down to the bone, close to the exterior margin of the medulla oblongata, parallel to the raphe. On protruding the chisel-shaped knife, the width of which was exactly that of one half of the medulla oblongata, one half of the latter was completely severed. After the operation, the animal generally lay apathetically on the affected side. A large number of the animals died soon after the operation, usually in consequence of a considerable hemorrhage, and thus could contribute nothing to the solution of the problem. Whenever the animals survived the operation at least twenty-four hours, the bulla ossea was removed and examined. On considering the results collectively as before, we find that in nearly all cases (nine times in ten) an alteration occurred in the mucous membrane of the bulla on the operated side. In two cases could be found only a greater injection, or a general moistening of the mucosa, but in the remaining seven cases a quantity—even if small—of serous or sanguinous fluid, which in one case amounted to 25 *ccm.* Particularly notable, however, was the condition of the bulla on the sound side. For in three fifths of all cases the same alteration was present on the sound side as on the one oper-

ated on, although in a minor degree. We are thus forced to assume for these cases a sympathetic affection.

In the *third* series of experiments, in which the upper cervical ganglion of the sympathetic was extirpated, we found in four consecutive cases the same result—that the bulla ossea on both sides had remained normal and unchanged. I only mention casually, as self-evident, that the well-known symptoms were connected with the above-mentioned extirpation—persistent injection of the vessels of the ear of the rabbit, together with contraction of the pupil.

In like manner the *fourth* series of experiments, in which the glosso-pharyngeus nerve was torn out as far as the lowest ganglion of this nerve (comp. Krause: "Die Anatomie des Kaninchens," p. 240), taught us that this operation was unable to exert any influence upon the condition of the mucous membrane of the bulla ossea. In the four operations performed by us, we invariably found the lining of the bulla ossea unchanged. From these experiments it appears to be certain that injuries to the sympathetic and glosso-pharyngeal nerves exert no visible influence upon the mucous membrane of the drum cavity of the rabbit; however, that injuries to the trigeminus, both at its roots in the medulla oblongata and in the cranial cavity in front of Gasser's ganglion, that is, where the trigeminus emerges from this ganglion, produce inflammatory alterations in the mucous membrane of the drum cavity, which may represent all stages of inflammation, from simple vascularization to purulent exudation.

Important though this positive result be, we still had to admit that we had solved but one half of our task. Of the disturbances of innervation in the region of the middle-ear nerves, we had examined only that part which was incited by *paralysis* of the respective nerves. There remained to us to study the intratympanic alterations after *irritation* of the before-mentioned nerves. We could not gain time for the execution of this SECOND PART of our task until during the winter course of 1880–1881, after I had reported the first part at the meeting of naturalists and physicians at Danzig (comp. the *Journal*, p. 257).

The experiments to ascertain the influence of irritation of the sympathetic, trigeminus, and glosso-pharyngeus nerves upon the mucous membrane of the drum cavity, or, to speak more exactly, upon the condition of the vessels extending within it, were made exclusively on cats, because we soon became convinced that the rabbit, which had served as test animal for the first part of our experiments, was unsuited to those we contemplated. The vessels of the mucous membrane of the drum cavity in the rabbit are too small to permit the recognition of distinctly visible alterations in their calibre, even under the greatest possible magnifying power. On the other hand, these vessels in the cat, especially when viewed with the magnifying glass, presented an exceedingly handsome aspect.

The chloroformed cat having been fastened to an operating board in the dorsal position, the head is fixed so as to make the vertex region touch the board, by means of a string attached to a strong wire-bit inserted into the mouth of the animal. Then an incision into the skin is made in the medial line of the neck, below the thyroid cartilage, and from three to four centimetres in length. On displacing the skin to the right and left, the trachea is seen to gleam through from below; not far from it on both sides is the carotid artery, and, in a lateral direction from the latter, the vago-sympathetic nerve. Still more laterally, and quite superficial, is the external jugular vein, which can be easily isolated. The trachea having been exposed, and a couple of rings having been opened, a glass canula is inserted into it. The other end of the glass canula is connected with a pair of bellows by means of a rubber tube, for the purpose of artificial respiration. Then enough curare is carefully introduced into the external jugular vein by a Pravaz's syringe to induce the first spasms due to asphyxia in the animal.

The vein having been ligated, artificial respiration commenced, and the animal freed from its bonds, the intended experiment can be started. Prussak,¹ under Ludwig's direc-

¹Dr. A. Prussak: *Zur Physiologie und Anatomie des Blutstromes in der Trommelhöhle. Bericht über die Verhandlungen der Königl. sächs. Gesellschaft der Wissenschaften zu Leipzig. Mathem. physical. Klasse, Bd. xx, 1868, p. 201.*

tion, having already tested the effects of irritation of the sympathetic on the condition of the vessels in the drum cavity of the dog, it appeared to us advisable to commence this second part of our work with the repetition of Prussak's experiments. We therefore exposed the right bulla ossea of a cat, carefully broke off small pieces of its osseous shell with needle forceps, until we had secured an opening of about one centimetre diameter; then we cut into the hitherto uninjured mucous membrane of the bulla, which adheres to the bone very loosely, and folded the flaps of mucosa back upon the margin of the bone. In this manner we had exposed the field for the observation. Nothing remained now but the adjustment of the illuminating apparatus and of the magnifying glass for the inspection of the vessels of the bulla. For the illumination we employed an apparatus ordinarily used for rhinoscopic examinations, the light-rays of which issue in a parallel direction. These light-rays were caught upon an otoscopic mirror and thrown upon the object of the examination. Between the latter and the mirror was inserted the bull's-eye condenser of a Hartnack microscope, fastened on a stand, but adjustable, to serve as a loupe. The whole apparatus, therefore, was absolutely firm, only the mirror was held in the hand; but even here an almost unchangeable position of the mirror was secured by resting the hand on the operating table. This precaution, however, was positively essential, as otherwise faulty illumination might have been caused. Another requisite for the undisturbed course of the experiment is the manner of the nervous irritation. It is not permissible to lift the exposed sympathetic out of the wound for each separate test, and to lay it upon the afferent electrodes of the induction coil, but it is to be recommended that it be placed in continuous contact with the wires leading the current, by means of Ludwig's¹ electrodes.

As regards the anatomy of the vessels in the drum cavity, they belong to the internal carotid and the tympanic branch of the internal maxillary artery. The arteries in the bulla,

¹ See their description in "*Arbeit. d. physiol. Arch. zu Leipzig*," Jahrg. 1875, p. 234, and E. Cyon, *Atlas z. Methode d. physiol. Experim.*, plate iv, fig. 3, A and B.

however, are so small that they, as already pointed out by Prussak, are barely recognizable even when magnified with the glass, so that we are chiefly confined to the observation of the veins. Like Prussak, we also have found it advantageous to observe the vessels continuously before, during, and after the irritation of the nerves; for "the experiment is a very delicate one." According to Prussak, at the beginning of the irritation of the sympathetic, the vessels dilate slightly at first, then they become paler, and remain in that condition as long as the irritation continues. After the termination of the experiment, the vessels become especially distinct. We can confirm Prussak's experiments in every particular, with perhaps the single qualification that the initial dilatation of the vessels, after the irritation, was not distinctly visible. We fully concur, however, with Prussak's statement that the experiment conducted in this manner is a very delicate one. We therefore decided to modify the experiment somewhat, and thus obtained quite certain, indubitable results. The modification of the experiment consisted, in the main, in leaving the bulla uninjured and obtaining an insight into the drum cavity from the meatus, after partial removal of the membrana tympani. In connection therewith, we dissected the cochlea, as far as the osseous auditory meatus, from the animal's skull, and, every hemorrhage having been carefully arrested, twisted the cochlea away from the skull at the osseous auditory meatus, during which operation barely a drop of blood escaped. Now the membrana tympani was fully exposed, as the osseous ear-canal is but a few millimetres in length. The vessels of the manubrium mallei of the drum being visible even to the unaided eye, we thought it opportune to first test the influence of irritation of the sympathetic upon the condition of these vessels, and afterward to make a hole in the membrana tympani to permit inspection of the drum cavity.

It is well known that the vessels of the membrana tympani originate from the cuticular vessels of the auditory meatus (from the arteria auricularis profunda and the arteria auricularis posterior). A few larger vessels stretch from the upper wall of the ear-canal transversely across the upper

section of the drum, and then immediately extend over the manubrium mallei as far as the umbo. The manubrium in the cat also extends from above anteriorly to below posteriorly, deviating slightly from the vertical direction; it is surrounded by a thin, translucent strip of cartilage. The appearance of the manubrium, with the two parallel vessels coursing upon it and the bilaterally visible, almost transparent strip of cartilage, is exceedingly handsome. As the two vessels contract gradually toward the umbo, their inferior extremity is barely recognizable even under the glass, while their upper part can be easily seen with the unaided eye. It is just this condition of the manubrial vessels which renders them particularly appropriate for our observation; for as they fill, the red thread of blood within them appears to lengthen, to cross at the umbo, and there form a loop. But if they contract, the ends at the umbo disappear first; then the paling proceeds upward, until finally the entire manubrium appears white. *On this object we tested the influence of irritation of the cervical sympathetic, and could convince ourselves to our perfect satisfaction that on irritation the vessels contract until they become invisible; that after the cessation of the irritation they refill and become even thicker than before the experiment commenced.* The duration of the irritation until the vessels disappeared lasted from five to ten seconds, and until their complete refilling after the cessation of the current, thirty to fifty seconds. In general, the lapse of time until the disappearance of the vessels coincided pretty closely with that until the greatest dilatation of the pupil; and the time until the refilling of the vessels, with that until the beginning of the complete contraction of the pupil. Repeated experiments having convinced us of the prompt effect of irritation upon the contraction of the vessels of the membrana tympani, we severed the posterior segment of the drum from the tympanic ring by means of a blunt needle. This operation usually succeeds without the loss of a drop of blood. The mucous membrane thus exposed looks very pale at first, but gradually it reddens slightly, probably in consequence of the irritation caused by the influx of atmospheric air. If the sympa-

thetic was then excited, we could observe with certainty a narrowing and paling also of the vessels of the tympanic mucous membrane; although not with the distinctness of the manubrial vessels, yet with far greater clearness than in previous experiments in which the bulla ossea was broken open, according to Prussak's procedure.

It is, therefore, proven, that *the sympathetic must be considered to be a vaso-motor nerve for the ear*. Although we have furnished the demonstration only for the external and middle ear, yet we cannot exclude the labyrinth, because we know that a part of the vessels of the drum cavity reach the labyrinth both by way of the fenestra rotunda and ovalis (Buck) and through the bony walls (Politzer).

In a *second* series of experiments we then tested the influence of irritation of the trigeminus upon the condition of the vessels of the middle ear.

The first experiment we conducted in such a manner that two needles at a slight distance from each other were introduced into the medulla oblongata of a curarized cat. The needles were connected by thumb-screws with the wires of an induction apparatus. Whenever we irritated the medulla oblongata in this manner, we could observe the paling of the vessels of the drum more speedily than in the preceding experiments. But as the centres of the most various nerves are situated in the medulla oblongata, no positive conclusion could be drawn from this experiment for the present; but, basing on the experience that irritation of the cervical sympathetic as well as irritation of the medulla oblongata produces contraction of the vessels of the membrana tympani, we might well venture the conjecture that the fibres of the sympathetic extending into the medulla oblongata may be the cause of the observed phenomena. In the same cat, therefore, the cervical sympathetic and the vagus were severed on both sides. The inhibitory action of the vagus on the heart we could not assume to be of much account in the curarized animal, for its division could only increase the positiveness of the experiment. Our conjecture was completely confirmed, for now, after irritation of the medulla oblongata, instead of the previously observed

contraction, we obtained an evident dilatation of the vessels of the membrana tympani. How should this vascular dilatation be interpreted? Could we refer it to an irritation of the root of the trigeminus? The well-known fact that irritation of the splanchnicus, the vaso-motor nerve of the abdomen, considerably increases the blood-pressure in the aorta by the contraction of all the terminal branches, led us to the conjecture that the vascular dilatation observed by us in the manubrial vessels after irritation of the medulla oblongata, at least to a considerable extent, should be referred to a purely mechanical filling of these vessels, inasmuch as the splanchnicus is excited conjointly with the medulla oblongata. In order to exclude from the irritation not only the splanchnicus, but all vascular nerves, which, as is well known, have their centres to a great extent in the medulla oblongata, we determined to sever the spinal cord close to the medulla oblongata in the next experiment. Unfortunately the cat on which this operation was performed lost so much blood that the experiment could not be looked upon as convincing. In like manner the succeeding experiments in which the spinal cord was divided did not turn out to our satisfaction. Several of them miscarried without any fault of ours, cats with diseased ears being repeatedly encountered. Usually the meatus was plugged with masses of cerumen, the membrana tympani thickened, opaque, at times also perforated, and exudation in the drum cavity. We were, therefore, unable to make any observation of the tympanic vessels, and on inspecting the vessels of the drum cavity we could see neither their contraction nor dilatation on irritating the medulla oblongata isolated in the manner above-described. In order to furnish proof positive that increased pressure in the carotid was followed by visible filling of the tympanic vessels, we instituted the following experiment: The thorax of a curarized cat was opened so as to gain access to the thoracic aorta after opening the sixth or seventh intercostal space. If then the aorta was compressed with the fingers or some appropriate contrivance, and the manubrial vessels were observed both during the compression and after its cessation,

we found that an alternate dilatation and contraction of the vessels actually occurred. In this way we had furnished positive demonstration that irritation of the medulla oblongata, without division of the spinal cord or the splanchnicus, by a simple simultaneous irritation of the abdominal vaso-motor nerves, had given rise to increased filling of the tympanic vessels, and that, therefore, the dilatation of the vessels must be interpreted as a simple mechanical replenishment. Hence we are forced to the assumption that the trigeminus and the glosso-pharyngeus nerves—which are also implicated in the irritation of the medulla oblongata—have no visible influence on the condition of the observed vessels. As the glosso-pharyngeus anastomoses with the trigeminus (as well as with the facial, vagus, and the carotid plexus of the sympathetic) by branches which extend into or from the petrous ganglion, an isolated irritation of either of those nerves was not to be thought of.

Finally, *to summarize the results obtained by our investigations*, we have found, first, that lesions of the trigeminus, both at its trunk and its roots, provoke inflammatory symptoms in the middle ear; but there are differences in the sequels, according to the location of the lesion. The greater intensity of the inflammatory affection occurring after intracranial division may be explained by the prolonged duration of the inflammation. After semilateral division of the medulla oblongata the animals die too quickly to permit the inflammation to reach its height. Still more noteworthy than the difference in the intensity of the phenomena, is the condition of the bulla of the uninjured side. Differing in this respect from intracranial division, we found as a result of semilateral division of the medulla oblongata almost invariably some secretion in the bulla of the sound side. Inclined though we were at first to regard this disturbance in the lining membrane of the middle ear as a sympathetic one, we still found no reason for the fact that such a sympathetic inflammation never occurred after injury to the trunk of the trigeminus, and we must leave it an open question whether perhaps a crossing of fibres takes place in the medulla, and a part of the trigeminus-fibres

extends to the middle ear of the other side. The acceptance of the latter assumption would make it self-evident that a lesion confined to one half of the medulla oblongata would affect both ears in the same manner, although in varying degree.

The investigations taught us, moreover, that the sympathetic must be regarded as a vaso-motor, and, according to the extent of our experiments, as an exclusively vaso-constrictor nerve of the entire ear, because a distinct narrowing of the auricular vessels was always observed after irritation of the sympathetic. On the other hand, we obtained negative results respecting the state of the vessels after irritation of the trigeminus as well as after injuries to the sympathetic, trigeminus, and glosso-pharyngeus. Prussak has already called attention to the fact that the constrictor action of the sympathetic, after its irritation, should lead us to suppose a dilatation of the vessels of the ear after paralysis of this nerve; the more so, as we know that division of the sympathetic is followed by filling of the arteries in other parts of the head. However, we fully concur with Prussak that the experiments have not borne out this supposition. Contrary to our expectation, the mucous membrane of the middle ear remained invariably pale, even when the division of the sympathetic had preceded the examination of the drum cavity by several days.

The most surprising result of our investigations, however, was the negative state of the middle-ear vessels both after irritation and after paralysis of the trigeminus, for soon after division of this nerve neither dilatation nor contraction of the middle-ear vessels could be observed. Nor could we, as stated before, observe any visible alteration in the fulness of the vessels by irritating this nerve. Although we could ascribe to the trigeminus neither vaso-constrictor nor vaso-dilator qualities, while division of its trunk or injury to its roots was regularly followed by inflammatory phenomena in the middle ear, it appeared reasonable to acknowledge, in this case, the influence of the neurotomy as a merely trophic one, that is to say, to refer it to the existence of special trophic nerves. If we compare the

process in the drum cavity with the so-called trophic keratitis, the phenomena in the drum cavity—protected as it is from injurious atmospheric influences—permit our drawing a more unambiguous conclusion in regard to the existence of these nerves—hitherto always considered doubtful—than the consequences of division of the trigeminus in the eye, which certainly permit of several interpretations. A traumatic otitis after division of the trigeminus could not be thought of, for the reasons stated.

To what extent practical experience may be harmonized with the results of our investigations must be the subject of a separate article.

KÖNIGSBERG, *April*, 1881.

THE INHALATION OF CHLOROFORM A CAUSE OF AURAL DISEASE.

BY CHARLES E. HACKLEY, M.D., OF NEW YORK.

WITH a view of calling attention to a matter that I have never seen mentioned in medical literature I would refer to a case lately seen.

A lady aged 40 years consulted me about her hearing ; she said that some eighteen years previously while hearing well, and, so far as she knew, with no disease of the ears or throat, she inhaled chloroform to complete narcosis for a surgical operation ; on awaking from the sleep induced, her hearing was much impaired, and had remained about the same ever since ; at no time was there tinnitus or pain. At a short distance she hears a distinct voice quite well, but cannot distinguish general conversation. Has had no treatment, and has not grown better or worse. The throat and membranæ tympani look normal, the Eustachian tube is pervious, and it would seem as if the amblyakousis (?) were due to some nerve derangement, probably of vascular origin.

This case alone would not be worth calling attention to, but it brought to my recollection two others which occurred in patients seen at the N. Y. Eye and Ear Infirmary. One of these I merely remember as being quite hard of hearing, as he claimed from inhalation of chloroform. The other was a man of middle age, who said he heard well until he took chloroform to have an iridectomy performed ; at the time I saw him he was entirely deaf, and he said the deafness came on during the narcosis. I have not the notes of these cases, and at the time doubted their accuracy. In the last

case, for instance, the iridectomy might have been called for by the results of a syphilitic iritis, and the syphilitic poison might have induced the deafness. In the rush of a large dispensary class, a full record of a case, possibly a coincidence, was neglected.

But a third case of a similar accusation against chloroform, has induced the present note. Anæsthesia by chloroform being rather unusual here, the opportunity of examining membranæ tympani of patients under its influence has not lately occurred to me.

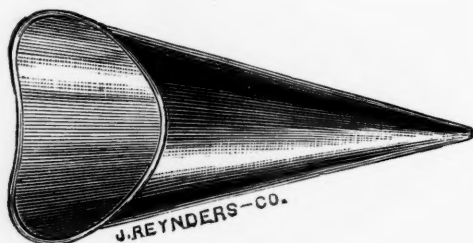
[Several cases of tinnitus aurium and loss of hearing have come under my observation, which were said to have been caused by the inhalation of sulphuric ether for the purposes of anæsthesia. It has, as yet, been impossible for me to decide as to whether or not anæsthesia by chloroform or ether does sometimes cause permanent congestion of the ear. The membrana tympani is sometimes found to be congested during the inhalation of ether.—D. B. ST. J. R.]

THREE AURAL CONVENIENCES.

BY F. M. WILSON, M.D., OF BRIDGEPORT, CT.

I. *An ear-basin.*

Cone-shaped, as seen by cut below ; made of sheet metal, japanned or nickel-plated. Its supposed advantages are: its greater capacity ; less liability to slop, a cone-shaped dish requiring much more motion to spill its contents than one of the usual shallow form ; the greater ease with which it is

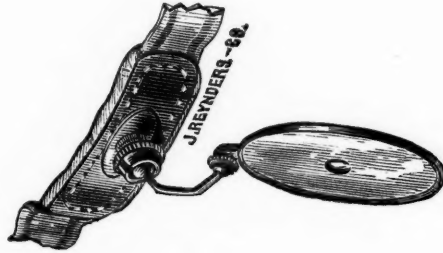


held in position ; and, lastly, being cut away in front, it is less in the way of the syringe. The cone is sixteen inches long, and seven inches in diameter at its widest part. The head is turned slightly to the opposite side, and the cone is steadied against the front of the shoulder when in use.

2. *An attachment for holding forehead-mirrors.*

As will be seen by cut, there are two ball-and-socket joints instead of one, and the one on the mirror is in front instead of behind it. Each joint can be loosened or tightened at will by rotation of the socket. There is greater freedom of

motion than could be obtained in any way with only one joint; and one motion, which is new, viz., movement of the whole mirror directly backward, so that it can be ad-



justed as close to the eye as a hand-mirror of the same size.

This is important, of course, only for those who look through the aperture.¹

3. *An inflation apparatus and ear-syringe combined.*



It consists of a hollow cylinder having stiff, hard rubber ends and flexible rubber sides. The sides are made to fold and open like those of a Chinese paper lantern, but are made stiff enough to prevent any displacement of their folds by the pressure of air or water. To one end is attached a flexible rubber loop for the thumb, into the other is screwed the nozzle, with a projection on it so that the fingers can grasp it and the apparatus be worked with one hand. The diameter of the end of the cylinder is about two and three-fourth inches, and its two ends can be separated from each other three to four inches. It is especially useful for work outside of the office on account of its portability.

¹ John Reynders & Co., makers.

A CASE OF EPITHELIOMA OF THE MIDDLE EAR.*

By CHARLES J. KIPP, M.D., NEWARK, N. J.

H. K., a very large and fleshy German woman, 50 years of age, applied to me for relief from a very severe pain in her right ear and head, in June, 1880. From her statement it appears that she has suffered from an offensive otorrhœa from right ear since birth, and that until a year ago she never had an earache. About three months ago a fleshy mass made its appearance in the external meatus, and has since then gradually increased in size. For the last month she has suffered intensely from pain in ear and head. About three days ago she first noticed that she could not close the lids of the right eye, and that the whole right side of the face was paralyzed.

On examination, the right auricle was found to be entirely normal. The external meatus was completely filled by a red, spongy, lobulated mass, which protruded somewhat beyond the plane of the meatus. Examination with the probe showed the mass to sprout from all sides of the external canal. In appearance the mass was not unlike a so-called "raspberry" polypus. The mastoid process was swollen, and its lower half of a dark-red color. This swelling was soft, but no fluctuation could be detected. The part immediately in front of the tragus was also considerably swelled, but its integument was of normal color. No pus could be detected. Although so much swelled, the parts around the auricle were not very sensitive to the touch. The right half of the face was paralyzed. The ear was deaf to every sound. The examination of the eyes with the ophthalmoscope revealed a perfectly healthy condition of these organs.

* Read before the American Otological Society at Newport, R. I., July 26, 1881.

Although pretty confident, from the peculiar character of the growth in the external meatus, that I was dealing with a malignant disease, I concluded to remove as much as possible of the fungoid mass for the purpose of giving vent to the pus which I supposed was pent up by the obstruction, and caused, in part at least, the great pain from which the woman was suffering. With the aid of the snare and scissors I succeeded in clearing the greater part of the external canal, and thereby gave exit to a quantity of extremely offensive, sanious pus. The middle ear was found to be filled with similar masses, which were, however, left untouched. Examination with a probe showed the walls of the external canal to be carious. The patient was ordered to syringe the ear with warm water, and the sulphate of morphia was given in large doses to relieve the pain. Although requested to present herself again on the following day, she did not return till ten days later, saying that the intense pain in head and ear had compelled her to stay in bed for a week. The external meatus was again completely filled by a fungoid mass, and on the lower half of the mastoid process there was now a soft, oblong, circumscribed elevation of livid color, about 3 *cm.* in length, which gave an indistinct sense of fluctuation. The integument of the part in front of the ear was now also of a deep-red color and more swollen, but no fluctuation could be made out here. The pain was excruciating. Hoping to give exit to pus, I made an incision into the swelling over the mastoid, but no fluid, except a few drops of dark blood, was evacuated. The swelling was filled by a fungoid mass. There being no longer any doubt as to the malignant character of the disease, I abstained from further surgical treatment, and ordered the fungoid masses to be dusted over twice daily with a powder composed of arsenious acid and hydrochlorate of morphia each 0.25 parts, calomel 2 parts, and powdered gum Arabic 12 parts,—a formula strongly recommended for cases of open cancer by a German surgeon whose name I cannot now recall. At the same time I gave sulphate of morphia internally, as before. For a while the growth of the fungoid masses appeared retarded by the powder, but within a month new masses broke through the skin over other parts of the mastoid, and also in front of the tragus. The patient was now scarcely able to separate the jaws on account of the swelling in front of the ear, and suffered also from great difficulty in swallowing, caused by the formation of a swelling on the right side of the pharynx. None but liquid food

could be taken, and only little of that. The fungoid masses in front and back of the ear continued to grow, and others made their appearance beneath the auricle, so that at last it remained attached only to the parts above. The stench from these ulcerating surfaces made it almost impossible to remain in the patient's room, although disinfectants were freely used. No swelling of the submaxillary glands or the glands of the neck could be felt. During the last week of her life she had numerous convulsions, which were followed by coma. She died about six months after I first saw her. No autopsy could be obtained.

The microscopic examination of the fungoid masses removed from the external canal showed that they were composed of large epithelial cells, with large and distinct nuclei, arranged in cylinders, which contained also many pearly globules. The cylinders were held together by scant connective tissue. The outline of many of the cells was serrated.

The above case derives its interest chiefly from its rarity. Besides the few cases collected by Schwartze (*Archiv f. Ohrenheilkunde*, Bd. ix, p. 216), I have been able to find but two others, one described by Lucae (*Archiv f. Ohrenheilkunde*, Bd. xiv, p. 127), and the other by Delstanche (Son) (*Archiv f. Ohrenheilkunde*, Bd. xv, p. 21). In the last-named case the disease started probably in the external canal.

Whether this was also the case with my patient it is, of course, impossible to say. Taking, however, into consideration the fact that the pain preceded the appearance of the growth in the external canal by some nine months, I am inclined to the belief that it originated in the deeper parts of the ear.

As regards the symptoms and the course of the disease, this case does not differ materially from those previously recorded. The chronic otorrhœa was, however, a feature which was present in but few of the reported cases. Whether this long-continued otorrhœa favored or caused the development of the cancer must remain in doubt. But in view of the well-established fact that cancer is not rarely developed in other parts of the body which are the seat of chronic inflammatory changes, it seems at least not improbable that the constant local irritation present in the in-

flamed textures of ears affected with caries, may cause the development of malignant disease (Roosa, Schwartze).

Although the peculiar attachment of the tumor to the walls of the external auditory canal, aroused suspicion as to its character on the patient's first visit, the case, when first seen, was so much like many cases of chronic purulent inflammation of the middle ear, with caries of the temporal bone, that the true nature of the affection was determined only by the microscopic examination of the fragments of the growth removed at the first visit.

THE CLINICAL DIAGNOSIS OF ACOUSTIC NEURITIS AND OF ATROPHY OF THE ACOUSTIC NERVE.

By D. B. ST. JOHN ROOSA, M.D.

A SUFFICIENT number of *post-mortem* examinations of ears whose history was well known by the means of careful examinations during the progress of affections of which they were either the sole seat, or in which they were involved, has long been considered to be the great want in the diagnosis of aural disease. This want has been quite fully met in the case of certain troubles in the middle ear, although much remains to be done in the case of chronic non-suppurative cases, of which patients seldom or never die. In the diseases of the internal ear we are of late also making progress. Such investigations as those of Moos and Steinbrügge, are constructing a pathology of the labyrinth and acoustic-nerve trunk, so that we may soon be able—even without that seemingly impossible desideratum, a sight of the central organ of hearing in life—to make an exact diagnosis of its affections. As a clinical observer, I am coming more and more to the conviction that we are able even now, in some cases, to determine the existence of acoustic neuritis and of acoustic atrophy. I will present in this paper a few cases in which the diagnosis may, I think, be made, and I shall endeavor to give the grounds upon which my conclusions have been formed.

CASE 1.—I. P. H., æt. 59, farmer. Sent by Dr. G. W. Holmes, April 26, 1880. The patient thinks he has been growing hard of

hearing for a year. The son (Dr. H.) believes that this period could be extended back to three or four years. He has some tinnitus, but this symptom does not seem to be a marked one. His ears have never received any treatment. He hears the watch R $\frac{c}{48}$, L $\frac{c}{48}$; my voice, in a room 50 feet long, 25 feet. The aërial conduction is said by him to be twice as loud as that through the bones. He has large auditory canals. Both membranæ tympani are depressed. The light spots are fully formed. There are opacities at the margin. Common air and vapor of chloroform, used by my attachment to Politzer's bag, redden the drum-heads, but the patient does not feel them enter the drum, nor does the hearing improve after the ears are inflated.

Remarks.—The points in favor of a diagnosis of disease of some part of the labyrinth or acoustic nerve in this case, to my mind, are:

1. The lessened conduction by bone.
2. The fact that although his ears have never before been inflated, no improvement results from forcing air into the tympana.
3. The entrance of the vapor of chloroform into the middle ear is not felt by the patient.

Only one of these points needs any comment, for two of them are pretty well recognized as giving color to the diagnosis of disease of the labyrinth.

Dr. Ely thinks, from some extended observations on this point, that in certain cases of affections of the acoustic nerve the patient fails to perceive the entrance of vapors into the middle ear, when we can be tolerably sure that air has really entered, and that this, in connection with other symptoms, makes a diagnostic point.

This clinical fact I am inclined to believe to be a substantial one, but I leave a discussion of it to my colleague at some other time.

Those who are inclined to make a diagnosis of disease of the middle ear from the appearance of the membrana tympani alone, will perhaps make one in this case, but I lay very little stress upon this appearance by itself. So long as there is a good light spot, I think even a partially sunken membrana tympani will do its work very well. Besides that,

there are cases of changes in the membrana tympani that are evidently secondary to disease of the central apparatus. Again, in childhood or youth, passing affections of the tympanic cavity leave changes upon the drum-head. They may be considered as analogous to certain opacities of the cornea.

The insidious approach of the loss of hearing in this case, the absence of nasal and pharyngeal symptoms, all incline me to believe, although I admit the evidence is slight, that atrophic changes have taken place in the acoustic nerve. If, however, I only had such cases as these to rely upon, that is, cases in which the history was no more full, I should simply make the diagnosis, as this one is, in fact, entered on my case-book, of disease of the labyrinth.

CASE 2.—Mr. S., æt. 46, sent by Dr. E. Dupuy, October 20, 1880. This patient is a large, well-developed man of great intellectual activity, who is engaged in great enterprises in the Western States. He leads a very irregular life, eats very rapidly and very much, takes long journeys very often, but he is not intemperate in the use of alcohol or tobacco. He began to have attacks of vertigo and nausea five years ago, so that he would be obliged to lie down for hours. He had to lie on his back; could not turn on his side or his belly. He thinks he observed tinnitus and impairment of hearing after the first attack. Ever since his hearing power has been variable. *He hears worse in a noise; low tones are heard best; music is disagreeable.* He has no pain in his ears; the attacks of vertigo are growing less frequent. Has a sense of general dizziness. Sometimes he falls in the street. He has flatulent dyspepsia. He never has had any venereal disease. Says he has been prescribed for by "20 aurists."

For the watch his H. D. is R $\frac{P}{48}$, L $\frac{0}{48}$; voice, 3 feet. The tuning-fork "C" is heard on the teeth "slightly"; not at all on the forehead, nor on any point of the skull, except on the tip of each mastoid. The aerial conduction is much better than the bone- on each side. His pharynx is granular. Both membranæ tympani are somewhat depressed; they are not of good color, and the light spots are small. The air enters each ear by Politzer's method, and after inflation the H. D. on the left side is $\frac{P}{48}$; before it was $\frac{0}{48}$.

Remarks.—This I believe to be a mixed case, that is to

say, one of the middle ear and of the labyrinth. But I believe the disease of the middle ear to be of slight importance, and not to be the cause of the great loss of hearing and the head symptoms. In this case my diagnosis is based upon:

1. The suddenness of the symptoms.
2. The fact that the patient hears worse in a noise.
3. That he hears low tones best.
4. That music is disagreeable to him.

The variableness of his hearing power, which, however, is never good, as I found by several careful examinations, is due, I think, to the catarrh of the tympanic cavity and Eustachian tubes, which he undoubtedly has. I do not think the symptoms of labyrinthine pressure are secondary to those of the middle ear, however, because he has submitted at various times to *anti-catarrhal* treatment, with no marked benefit. Speculation as to the pathology of the lesion of the acoustic nerve is perhaps useless; yet I cannot but suppose that in this case either an inflammatory or a hemorrhagic exudation has occurred. There is no record that the patient's urine was examined. I think it was, however, with a negative result. A regular life was advised for the patient, but this he declined, and I anticipate that I shall one day hear that he has succumbed to central disease.

CASE 3.—J. J. Mc——, postal agent, æt. 40. Sent by Dr. Collins, March 11, 1881. When a boy suffered from tinnitus. Until one year and a half ago heard well. His attention was called to his impairment of hearing by his friends. *Does not hear as well on the railway cars as other people.* His occupation keeps him on the railway more than half of the time. It is worse when he is tired; appears to be in good health; never has had venereal disease; temperate. H. D., R $\frac{0}{48}$, L $\frac{0}{48}$.

Voice, about one foot from the ear, not well even there.

The bone-conduction is somewhat better than the aerial on both sides; both are feeble.

Membrana tympani of right side is hyperæmic; there is no light spot. Left side *Mt.* is pale, and there is no light spot; pharynx normal.

Remarks.—In this case I base my diagnosis upon the following facts:

1. Inability to hear better, or even as well as ordinarily, in the noise of a railway carriage.
2. Feeble bone- and aerial conduction.
3. Absence of nasal and pharyngeal symptoms.

I think acoustic neuritis has supervened upon a chronic non-suppurative inflammation of the middle ear; that he had an affection of the middle ear in childhood is shown by the testimony as to tinnitus, and the appearance of the drum-head.

Then again, the tuning-fork, although feebly heard through the air as well as through the bones, is rather better heard through the bones than the air. But that he had serious disease of the acoustic nerve is, I think, indicated by the fact that he not only did not hear better in the noise of a railway carriage than when in an ordinarily quiet place, but that he heard worse than people in general. This symptom I think one which is of considerable importance. I am persuaded that in all of the cases in which the human voice is heard better in a noise, there is predominantly disease of the middle ear, and that the reverse is true. Where, in a case of impairment of hearing, the human voice is not heard better in a noise, and where, on the contrary, noise is distracting and confusing, there is, I believe, disease of the acoustic nerve. The hyperæmic drum-head unattended by pain indicates, I think, hyperæmia of the whole apparatus, and I would classify this also as a mixed case, but one in which the nerve was predominantly and chiefly affected.

CASE 4.—I. W. L., æt. 19, sent by Dr. Selden, of Catskill, April 2, 1881. "On the evening of February 27th, of this year," writes Dr. Selden, "I was called to see this young man, who had just arrived from New York, where he was taken sick. I found him suffering from severe congestion of the brain, with cold extremities and surface. He was unconscious and delirious. Four days after he became fully conscious, when it was found that he was entirely deaf. There was marked vertigo, which still continues to some extent, as well as the deafness, which is total," Added to this history, I learned from his brother that his illness came

after exposure to cold and damp, while greatly overheated as a fireman on a river steamboat. He is nearly absolutely deaf, and has constant tinnitus and dizziness. Is large and well developed. He has had no venereal disease. He hears the tuning-fork when placed on the mastoid, but feebly. His vision is normal. Talks in an unnatural way, that is, without good modulation. The diagnosis is in this case not doubtful. It is descending acoustic neuritis. I gave a bad prognosis as to the deafness, and advised iodide of potassium and counter-irritation.

June 18, 1881.—I saw the patient again and received a note from Dr. Selden, in which he says: "In accordance with your idea, I put him on potass. iodid. and pushed it to the verge of intolerance. The vertigo has, as he informs me, left him." I found his condition as to hearing-power unchanged. His general health was excellent, his intellect sound, and I advised no further treatment.

The evidences of disease of the labyrinth in this case, to my mind, are:

1. The history of primary cerebral or meningeal disease.
2. The nearly absolute deafness.
3. Inability of the patient to hear his own voice well.

CASE 5.—P. C., lawyer, æt. 51, sent April 25, 1881, by Professor Alfred C. Post. For 18 years the patient states that he has suffered from hardness of hearing. There is no other aural symptom. He has had no sore throat, no tinnitus. He never has observed that he hears better in a noise. If he hears any better the difference is not marked. He has worked very hard as a lawyer. He is large and well developed, but looks somewhat fagged and worn. No venereal; is temperate. Never has submitted to any aural treatment. H. D. for watch, R $\frac{5}{48}$, L $\frac{8}{48}$. Voice 6' behind him. The aërial conduction is better on each side than the osseous, but the difference is not marked. The pharynx is catarrhal. Is getting worse slowly. Right membrana tympani normal.

Left, a small light spot. Common air is not felt to enter the ears by Politzer's method. Chloroform vapor is then used and is felt. The hearing distance is less after the inflation.

Remarks.—This is believed to be a disease of the nerves, for the following reasons:

1. The absence of any symptom but loss of hearing.

2. The results of the tests by the tuning-fork.
3. The hearing does not improve in a noise.
4. No benefit results, but rather harm, from inflation.

I think the history, in connection with the objective symptoms, leads to the suspicion that the character of the lesion, if any, of the nerve, is atrophic. It is fairly analogous, I think, to a certain class of cases of atrophy of the optic nerve.

CASE 6.—Miss F. W., æt. 16, sent by Dr. C. S. Merrill, of Albany. The patient's mother states that she discovered that her daughter heard badly a few months ago. Careful cross-examination shows that the young lady has not heard well for years, but that she has grown very much worse during the last few months. She is very skilful in concealing her defect, by watching the mouth of the speaker. Patient is a slight, delicate, nervous patient. She began to menstruate at 13 years of age. Has leucorrhœa; H. D. for watch, R $\frac{P}{48}$, L $\frac{0}{48}$. Does not hear the voice well, even when the words are spoken directly into her ear. On the right side she does not hear the tuning-fork through the air or bones; feebly on the right side, rather better through air than through bone.

Both membranæ tympani are sunken, and the light spots are irregular in shape.

By Politzer's method air is not felt to enter the ears, but the vapor of chloroform is noticed. No improvement in hearing results, but an attack of hysteria followed.

Remarks.—The reasons for my diagnosis of lesion of the acoustic nerve in this case are:

1. The nearly absolute deafness (absolute on one side).
2. The results of the examination by the tuning-fork.
3. The absence of annoying tinnitus.

That the lesion is rather atrophic than actively inflammatory, I think may be concluded from the general debility of the patient, and the absence of head symptoms. That it is not hemorrhagic, is, I think, tolerably well assured, from the fact that the deafness came on gradually. The disease of the nerves may have been secondary to catarrhal trouble in the middle ear. This, I think, is probable, for although I could not get a very intelligent or exact history, there

was a vague idea on the part of the mother that "colds" and "pneumonia" were the cause of the first aural symptoms.

CASE 7.—W. D. C., æt. 41, sent by Prof. Gouley June 25, 1881. This patient was sent to me, but I did not see him for some days after my associate, Dr. Edward T. Ely, had made a diagnosis, in which I fully concur.

The patient was seized with mumps three weeks ago. Deafness of the left ear appeared suddenly two weeks since. There has been dizziness for one week. This was marked in walking, in sudden movements, and in looking upward. The sensation at times is as if he were pulled backward. He says the sensations are like those from alcoholic intoxication. There was some dulness of hearing in the right ear, but that has passed away. He travelled while he was suffering from parotitis. There was no pain in the ear. He had no rational treatment for the aural trouble. Since the deafness appeared there has been constant tinnitus. In 1867 the patient had a venereal sore, and a general eruption afterward. Had no other symptoms of syphilis. He is married, and has six healthy children. Noises of the street are very annoying to him.

The H. D. R $\frac{3}{4}$ 0, L $\frac{P}{4}$ 0 (?). The tuning-fork placed on the teeth is heard only in the right ear. In the left ear the tuning-fork is not heard at all through the air. It is heard on the mastoid, but probably by the right ear, as plugging the right ear intensifies the sound. Plugging the left ear makes no difference. The drum-heads are depressed, and the light spots are small. His voice sounds only "one-half" to him. After inflation by Politzer's method, the watch is heard when pressed upon the left ear, but probably with the right, as plugging the right intensifies it. The fork is not heard.

Remarks.—The diagnosis in this case is based upon:

1. The suddenness of the occurrence of nearly absolute deafness.
2. The evidence of the tuning-fork. It is heard only in the good ear.
3. Noise is distressing to the patient.

Dr. Ely made a diagnosis in this case of "Affection of the labyrinth after mumps." I believe the case

to be one of acoustic neuritis, and that the cochlea or nerve trunk are the parts chiefly involved. Whether it was a so-called metastatic inflammation, similar to metastatic orchitis, so often seen after this disease, I am unable to say. But I think it more probable that the disease passed through the tympanic cavity, where it caused a slight catarrh, and entered the cochlea through the fenestra ovalis and vestibule, or by the fenestra rotunda. In the right ear there was undoubtedly a moderate inflammatory process, which seems to have been confined to the tympanum. The access to the ear, through the auditory canal and middle ear, by the parotid gland, is certainly anatomically easy, and I do not know why we should seek out another means of communication to explain the transference or continuance of an inflammation of the parotid gland to the ear. The fact that only a slight affection of the tympanic cavity occurred, is nothing against the notion that the cochlea, which tolerates very little, while the middle ear may undergo much without great impairment of hearing, was seriously impaired as to its functions by the inflammation. There is a direct connection of the two parts of the ear, by means of blood-vessels, and I confess to surprise at the difficulty which is found by some authors in knowing how a disease passed from the parotid gland to the cochlea. I have already alluded to this fact in my text-book, p. 539, fourth edition. The influence of the venereal disease, I think, may be considered as of no account. In the treatment, however, Dr. Ely and I thought we were giving the patient the benefit of a doubt by practising inunction, and administering iodide of potassium. The patient was kept under observation for eleven days, and was treated by the use of leeches and mercury and iodide of potassium, and the avoidance of noisy places. At the end of that time he thought the tinnitus and dizziness were less; the hearing was as first noted. Judging from similar cases, I suppose this patient will recover from the distressing head symptoms, but never from the deafness. The inability to bear noise, as I long since pointed out, is, I think, a symptom of acoustic neuritis.

The cases thus presented have been taken from my case-

book of the last year. They are presented to show that with our present clinical knowledge we are able to differentiate with considerable certainty as between diseases of the middle and internal ear, and that we may perhaps even begin to isolate different forms of affections of the acoustic nerve. To my mind the tuning-fork has done much to assist us in classification. It seems to be supposed by some writers (see Burnett, *American Journal of Otology*, No. 3, 1881, p. 200) if the tuning-fork be heard in both ears when on the vertex, that no disease of the labyrinth can exist. Now I believe, even if the tuning-fork be heard in both ears, but more indistinctly in the bad ear, that disease of the nerve may be diagnosticated. I beg to refer to my paper on this subject read at the last meeting (1881) of the American Otological Society.

Diseases of the trunk of the acoustic nerve, and its expansion into the labyrinth, continue, happily, to bear a very small proportion in the total of aural affections. Hopeless as the prognosis is now in nearly all of them, we may believe that, as the acquisitions of clinical and pathological experience begin to be sifted, we shall even in this direction find much worthy of our search. Certainly, the patient will often be spared much tentative and useless treatment, if we are always able to make a diagnosis.

INVESTIGATIONS REGARDING THE OCCURRENCE
AND THE IMPORTANCE OF COCCOBACTERIA IN
PURULENT OTORRHŒA, AND THE THERAPEU-
TICAL INDICATIONS FURNISHED BY THEIR PRES-
ENCE.

By B. LOEWENBERG, OF PARIS.*

Translated by ISIDOR FURST, of New York.

PART I.

MICROSCOPICAL APPEARANCES.

I N the initial chapter of my treatise on "Furuncle in the Ear and Furunculosis" (published in the *Progrès Médical*), I have laid stress upon the fact, that I was surprised by the excessive quantity of micrococci invariably found when I first began the examination of the pus secreted in aural furuncle. It so happened that the first patients suffering from furuncle in the auditory meatus, consulted me after the furuncles had opened and pus had been effused into the auditory canal, and when I commenced my studies upon them it remained doubtful for a time whether I had to deal with the cocci characteristic of this affection, or with other, as it were, more virulent ones. Soon, however, I was convinced that certainly not every thing found belonged to the former, and this opinion was confirmed by Prof. Pasteur, to whom I submitted a sample of these micro-organisms, who assured me positively that they were not the microbia characteristic of furuncle.

* To some extent taken from a paper read by Dr. Loewenberg at the International Otological Congress, Milan, September 7, 1880.

Since then I have had abundant opportunity to examine furuncles of the meatus *prior to their opening, i. e.*, before the pus formed in them had come into contact with the atmosphere. These experiments consisted in the cultivation, in beef-soup or diluted Liebig's extract of meat, of pus freshly obtained by opening the abscesses. They demonstrated with certainty that the coccus of furuncle, purely and abundantly produced by these experiments, deviates morphologically from that found in patients affected with otorrhœa; for instance, in constantly exhibiting greater dimensions.

Since acquiring this knowledge, I have repeatedly, from beginning of June, 1880, to date, subjected to a careful examination the products of secretion of the affected organ in all patients coming under my care, in order to enable me to study the nature of the respective microphytes. The examination consisted, on the one hand, in the microscopic study of the pus (with all its accompanying detritus) obtained by syringing or otherwise; on the other hand, in attempts at cultivation, partly in the above-mentioned media, partly in boiled neutralized urine. Of course, these experiments were made with all the precautions indispensable in such cases, *i. e.*, subjecting all vessels and instruments to a red heat, and parallel experiments with samples of the nutritive fluid without the addition of the pathological products. As it is possible, *a priori*, that the cotton employed for closing the vessels may contain germs, I always heated it, before use, in some receptacle—a precaution of which I can find no mention anywhere, but which perhaps is not superfluous.

These experiments demonstrated that in all these cases we had to deal with the ordinary *organisms of decomposition*. *In all cases of otorrhœa in which the cleansing of the ear is not done with the greatest care and by the aid of suitable apparatus, the pus contains more or less great numbers of micrococci. If, in consequence of persistent neglect, the secretion is allowed to become offensive, the micro-organisms swarm in incredible quantities.*

Whoever is to some extent familiar with the morphology

of the minute creatures occurring during decomposition of animal or vegetable substances, will find this fact perfectly natural; he would expect *a priori* that on admission of air stagnant pus could not long remain free from those microphytes, and that they, when decomposition has become fetid, must be met with in a high stage of development.

In this connection I state with decided emphasis that, contrary to the belief prevalent even in some competent circles, the pus secreted in simple purulent otorrhœa, in its fresh state, is as little offensive as that from other diseased mucous membranes, simply because of the absence of any cause therefor. Feter then, according to my opinion, points to stagnation and a high degree of decomposition dependent thereon, the existence of which is proved by the presence of micrococci.

Hiller expresses himself to the same effect in his book,¹ a work that cannot be too highly commended: "We may confidently assume that, whenever the smell of H_2S or H_3N is clearly perceptible in a dead animal body or part of it obtained from the household, putrefactive decomposition has set in and has progressed to the *formation of terminal divisional products*."

I found the most abundant multiplication of cocci where the ear had been treated with *emollients*, particularly with *cataplasms* (compare also my treatise on "Aural Furuncle," etc., *loc. cit.*). The bacteria under consideration require for their development oxygen,² warmth (particularly a temperature between 30° and 35° C.), water, and organic substances, from which they derive C and N, together with certain salts.

To be sure, they find all these aliments in an ear containing pus: a temperature very close to the central one, moisture, and organic substances withdrawn from the vital influence, viz., the pus itself and the products of the epidermo-epithelial desquamation. If cataplasms increase the moist heat and contribute additional organic materials, we have an actual hot-house culture of the bacteria. The above-men-

¹ Arnold Hiller: Die Lehre von der Fäulniss. Berlin, 1879, p. 68.

² S. Paschutin, *Virchow's Arch.*, Bd. lix, pp. 3 and 4.

tioned condition explains the fact well known to all experienced otologists, that after prolonged employment of cataplasms almost interminable purulent processes in the ear often remain behind. Under the just-described, certainly unintentional artificial cultivation the putrefactive organisms reach a high degree of development, and in their turn keep up the prolonged suppuration. By a similar furtherance of the development of micrococci, though of a special character, we may interpret the fact that after continued application of poultices outbreaks of furuncles may be incited in any part of the body. In this connection I cite an interesting observation made by Dr. Nepveu before the Société de Biologie, which proves that a cataplasm may not alone further the development of bacteria, but may be the *carrier* of them. According to this expert observer, in one of the Paris hospitals, "a number of bacteria and cocci were found in the linseed meal boiling slowly in a pot over the fire"; such a cataplasm not only carries the aliment required by these parasites, but also the microphytes themselves or their germs, ready for immigration and multiplication.

I now return to my special case—that of the development of micrococci in suppuration of the middle ear. Here, in all cases in which the abundant development of schizomycetes pointed to an advanced stage of putrefaction, I found the following quite surprising condition: All the coarser solid parts, particles of epidermis or aggregations of pus-corpuscles, were invested with an envelope of closely packed but very small micrococci, which concentrically surrounds any and every particle of detritus to an equable depth, and in optical sections appears as a rather broad strip.

Further examinations have shown this concentric *gelatinous envelope* to be constant in all cases in which the pus stagnates in the ear. It must not be supposed that it was a casual agglomeration, or one due to mutual attraction, but a really connected aggregation of micrococci representing a peculiar formation. It can easily be demonstrated that it was not merely a coherent layer. If strong pressure is

exerted on the preparation through the covering glass, or if a reagent or coloring matter for schizomycetes is added, or if the surrounding liquid is sucked out by blotting paper, the whole formation is often detached *in toto*, and it can be plainly seen that the several punctiform cocci are connected together by a hyaline, apparently tough mass, the fundamental substance of the concentric envelope. How tenaciously this layer adheres to every particle of detritus is demonstrated by the fact that such a relatively rough procedure as a free syringing of the ear is often incapable of detaching it—as is shown by the examination of the pathological products removed in this manner.

Evidently, we here have to deal with one of the most characteristic morphological images of putrefaction, the so-called *zoöglæa*—a constructive formation, as is well known, peculiar only to the spherical and rod-bacteria among the schizomycetes, and lacking to the others, *e. g.*, spirilli. While the several individuals of the two first-named groups of schizomycetes are rapidly multiplying by division, they form under certain conditions that muco-gelatinous, coherent, and well-defined mass which has been variously interpreted and named since the time of Burdach. The term more generally employed is that proposed by Prof. Cohn, of Breslau,—“*zoöglæa*.” Prof. Billroth distinguishes gliacocci and gliabacteria (see his work on *Coccobacteria septica*, 1874). According to the first-named author, the form *zoöglæa* must be carefully distinguished from that named by Pasteur “*mycoderma*” (this term was proposed as early as 1872 by Persoon); the latter lacking the mucoid fundamental substance which characterizes the former.

According to Prof. Cohn, the *zoöglæa* owes its origin to a process of imbibition, a swelling of the cell-membrane of the bacteria (Cohn, *Beiträge zur Biologie der Pflanzen*, Bd. i, 2, p. 141), which is greatly favored by an unimpeded access of air. With all due deference to such a distinguished investigator, I must raise some objections to this (otherwise generally accepted) mode of explanation. Even assuming the existence of a cell-membrane in the smallest of all living beings—the micrococci, as incontestably proven,

which often appear only as points under the highest magnifying powers—it appears to me very extraordinary that these undoubtedly very delicate membranes should be able to swell to such an extent as to separate the cocci to the degree often observed in this gelatinous envelope. (I propose this name, on the one hand because it saves us from a foreign term, on the other hand because *zoön* would designate the fungi as animals.) Besides, as far as my experience goes, the several individuals in this aggregation possess the same sharp outline as those floating about singly which do not belong to the gelatinous form, that is, they show no indication of a swelling of the membrane encircling them. Otherwise the vital qualities of the cocci seem to me to be the same there as in their free condition.

All these facts may be taken as evidence against the theory that this form arises from swelling of the cell-membrane, and I propose the following new hypothesis in its stead: *It seems probable to me that the gelatinous envelope (Zoöglæa, Cohn) is a PRODUCT OF SECRETION OF THE COCCI OR BACTERIA.* I refer to the assumption of reliable bacteriologists that these fungi are capable of excreting various substances. Thus many authors explain the toxic effects of schizomycetes in the animal body by the power these minute and at the same time powerfully active corpuscles have to excrete very deleterious substances (*e. g.*, Schröter in Cohn's Beiträge, i, 2, p. 109; Koch, etc.). In analogy with these facts I assume that the gelatinous envelope is the optically recognizable product of a similar excretion, and this hypothesis appears to me more plausible than the one hitherto prevalent, in view of the objections above specified.

It is well known that a similar formation of gelatine occurs also in other low organisms, *e. g.*, in the monocellular algæ (comp. Prazmowski, cited in *Botan. Centralblatt*, 1880, p. 37). It may also be observed in *Euglena viridis*, and in that case has even been taken as a specimen *sui generis* and named "microcystis Nolli." *Euglena* is said to be a plant, not an infusorium, as hitherto believed. (Hofmeister, "Handbuch der physiologischen Botanik," i, p. 29, Note 4, 1867.)

SPECIAL MORPHOLOGY OF THE MICROPHYTES FOUND IN OTORRHOEA.

I.—*Micrococci or Spherical Bacteria.*

I have stated above that the cocci which I observed in the stagnant pus of otorrhœa, are absolutely the same as those ordinarily occurring in putrefactive decomposition. They appear as exceedingly minute punctiform or slightly oblong corpuscles. Often several may be seen grouped in a manner which would lead us to suppose a preceding multiplication by division, which manner of propagation, it is well known, is peculiar to the entire class, and has given rise to the names of schizomycetes or schizophytes.

Frequently chains of two, three, or more are found arranged lengthwise; again, groups of four or five in pretty cross form. As appears from a communication to the *Centralblatt f. d. med. Wissensch.* (July 12, 1879), Dr. Neisser regards this crosswise arrangement as characteristic of gonorrhœal pus, but I can give the assurance that I have frequently found it in the product of simple otorrhœa.

II.—*Rod-bacteria.*

In speaking heretofore only of micrococci without naming other groups from the class of schizophytes, I did so because, in the vast majority of the cases examined, the former structures alone were present. This fact is not surprising to those familiar with the microscopic examination of putrid substances; on the one hand, it is just these organisms which in the decomposition of organic tissue appear first and play the chief part; on the other, their occurrence is especially characteristic of animal fluids abounding in albumen, because they stagnate on free admission of air. Under these circumstances Prof. Billroth already observed only the smallest forms of schizophytes in pus and blood, and Dr. Hiller also observes (*loc. cit.*, p. 299): "In albuminous media, *e. g.*,

blood, pus, and animal tissues, the small form of cocci usually predominates—at all events, it always appears first.” During the stagnation of pus in the middle ear and in the meatus, quite analogous conditions prevail, and the identity of the microscopic images in both cases, therefore, is any thing but surprising.

Having sufficiently emphasized that in all cases where the strictest cleanliness is not observed (and, as we shall see later on, appropriate treatment instituted), spherical bacteria show themselves as the peculiar typical concomitants of suppuration of the ear, I must yet add that I certainly found rod-bacteria likewise, in a few cases. In view of the theoretical and practical importance of the subject, I think it imperative to report these cases more in detail.

I. *First observation.*—D., æt. 13, is brought to me October 13, 1880. The patient, a weakly child of scrofulous habit, exhibits the tooth-formation described by Hutchinson, and suffers from bilateral keratitis. A few weeks ago, it is said in consequence of using Weber's nasal douche, an acute inflammation of the drum-cavity of the right ear ensued, which soon terminated in perforation and suppuration. Treatment to date: instillation of a weak solution of alum, occasional syringing of the ear. The latter part of the treatment has evidently been insufficiently performed, for the fundus of the right meatus is filled with a brownish, smeary, offensive mass. After careful syringing, a very large perforation is seen in front of and below the manubrium mallei. The mucosa of the drum-cavity is slightly reddened; otherwise nothing notable is to be observed, the case generally exhibiting nothing extraordinary except in the microscopic appearance.

Microscopic examination of the matter obtained by syringing.—All fragments, such as remnants of epidermis, aggregations of pus, etc., are surrounded by the concentric micrococcus-gelatin; besides, there are some small *rod-bacteria* with their characteristic motion. With these are seen some peculiar, not easily explained formations, namely, ellipsoid or lemon-shaped bodies, of equal size with the accompanying epithelial cells and full of punctiform granules. They bear a remote resemblance to Prof. Billroth's ascococcus, only the latter form has a more irregular outline, and, according to their discoverer and Prof. Cohn (*loc. cit.*, i, 3, pp. 151 *et seq.*),

they are enclosed in a gelatinous envelope, while the bodies here seen are quite free and have a distinct outline.

Results of Cultivation.

With small quantities of the recently evacuated masses I made attempts at cultivation, observing the customary precautions, and obtained the following results :

1. *Cultivation in fresh and alkalized beef-soup.*—(The temperature of the room varied between 10° and 15° Cent.) On the day following the beginning of the experiment, vast increase of the micrococci, while the bacteria have not multiplied at all, or only very slightly. The cocci form chains; in some places I observed the following *phenomenon*, not previously described, to the best of my knowledge. Two clearly distinct cocci, in vivid molecular motion, tear one another hither and thither, as if joined by a bond invisible to our highest powers. Perhaps we had here a stage immediately preceding a definitive fission?

On the second day after commencing the experiment, the liquid has an acid reaction and exhibits brisk development of gas. It contains many rather oblong micrococci, united into chains or hives. Here and there are seen some coarser granules which do not consist of fat, as shown by the refraction and reagents. Of bacteria there are only some extremely sparse imperfectly developed specimens.

2. *Cultivation in fresh beef-soup without the addition of alkalis.*—Temperature as above; cocci and bacteria likewise, but much more sparsely developed. On the fifth day after the beginning of the experiment, a very unpleasant odor is perceptible in the nutritive fluid, somewhat like decaying fish; there is no evolution of gas. Positive absence of bacteria.

I state in this connection that the vast increase of the smallest corpuscles during the attempts at cultivation proves that I have not made the mistake occasionally committed by some authors, of mistaking granules of detritus for micrococci. It is well known, and I have called attention to it elsewhere (treatise on "Furunculosis"), that granules of detritus resulting from the decomposition of tissue may at times be easily mistaken for cocci, particularly in certain media, in which reagents and staining fail us (see *e. g.*, Cohn,

Beiträge, Bd. i, 2, p. 149). For such doubtful cases I recommend attempts at cultivation (preferably on the heated stage); they will certainly decide whether the one or the other kind of corpuscles are present, because micrococci multiply rapidly in congenial fluids, while particles of detritus of course remain *in statu quo*. I do not recollect to have seen the recommendation of this simple method in any other place.

II. *Second observation.*—Mr. T., æt. about 40, consulted me on October 4, 1880, for a chronic eczema of the right external auditory meatus. This affection, it is well known, causes troublesome itching, and in consequence thereof reckless scratching, often leading to quite serious complications for the ear. Thus, in Mr. T., at that part of the osseous meatus where he used to scratch with particular violence, is seen an oblong narrow strip in which the probe *encounters rough bone*. Microscopic examination of the scant, very fetid secretion shows the characteristic coccus envelope, together with some minute, very active bacteria.

III. *Third observation.*—" *Bacterium capitatum*."

This is one of the first cases in which I recognized the other above-described forms while trying to find, in furuncles of the ear, the micrococcus which Prof. Pasteur had discovered in furuncles of various parts of the body.

The patient, a lady of 73, and belonging to the highest circles, had, before seeking my assistance, according to her statement, a series of furuncles in the right auditory canal. The treatment consisted in the application, or rather the introduction, of cataplasms which the patient made herself, of pointed shape and small size, to enable her to introduce them deep into the meatus. All inflammation had ceased some time since, and patient consulted me merely for the impaired hearing in the right ear.

On examination, I found the right canal quite filled with various masses, partly of purulent, partly of epidermoid nature, together with all sorts of detritus. Immediate microscopic examination exhibited the usual cocco-gelatinous envelope, besides real (rod-) bacteria, many of which had the following quite peculiar form: At one end they had a swell-

ing, strongly refracting the light, approximatively at least twenty times the size of the cocci floating around them. Some of these bodies were also seen free, that is to say, unconnected with bacteria.

To some extent they resembled fat-globules, at least in their refractive power, but were distinguished from them by their peculiar shape, their constantly even size, and their behavior toward reagents, as, for instance, ether, which latter could be successfully employed, there being no mucoviscid medium present.

To the best of my knowledge, the first description and illustration of a similar form appeared in the—for that time—excellent book of Perty (*Zur Kenntniss kleinster Lebensformen*, 1852, see fig. 26, *b, c, d*, *Sporonema gracile*). Corpuscles of similar shape, but consisting of starch-flour, were described in 1868 (*Comptes Rendus*) by Trécul as amylobacter, urocephalum, etc. Davaine observed bacteria with expanded extremities in a fluid of maceration, and described them as *Bacterium capitatum* (*conf.* his article, *Bactérie*, in the *Dict. encycl. des Sc. Méd.*, Bd. viii, 1868, p. 24). According to Cohn, such a form produces the peculiar ferment which changes milk into cheese and is identical with Pasteur's ferment butyrique. (See Cohn in his *Beiträge*, Bd. i, 3, p. 194, *et passim*; Pasteur, in *Comptes Rendus*, 1864, Jan. 18th.)

More recently, Billroth's investigations have advanced the subject materially; according to him, the strongly refractive corpuscles are simply the *persistent spores* (or persistent ascos spores) of the "cocco-bacteria." It is they which, despite heat, cold, drying, and other physico-dynamic influences, effect the continuation and spread of schizophytes. In respect to appearance and micro-chemical behavior, the corpuscles observed by me corresponded closely with Prof. Billroth's persistent spores (*comp.* "Cocco-bacteria septica," by the same author, plate iv, fig. 37, especially the upper part of the figure).

Compare also the interesting article by Dr. Koch on the spores of *Bacillus anthracis* (in Cohn, *Beiträge*, Bd. ii, pp. 287 *et seq.*, with excellent photographs of these minute

objects), and his pamphlet: *Ueber die Aetiologie der Wundinfectionskrankheiten*, 1878.

If in the present case the peculiar corpuscles must be regarded as spores of bacteria, it may be asked why such "proliferation" should have occurred just here, as opposed to the other observations made by me. Was it, perhaps, the continued filling of the auditory meatus with cataplasms, together with the products of inflammation and suppuration, which gave rise to such a forced cultivation, the favorable conditions for which were lacking in the other cases? This, of course, is nothing but a hypothetical explanation.

In connection with these special microscopical studies, I am reminded of a verbal communication made to me by the late Prof. F. A. Pouchet, of Rouen, who, as early as 1864, informed me that he had found bacteria in the pus of a case of otorrhœa whenever itching had been present. I frankly admit that at that time my attention, as well as that of the entire medical world, was but little directed toward these micro-organisms in reference to their pathological importance, and I did not recall that remark to mind until my investigations into the occurrence of schizomycetes in ear-affections had yielded the results here reported, and when I was surprised by the absence of the actual (cylindrical) bacteria in most cases (see also *Comptes Rendus*, November 4, 1864).

IV and V.—*Observation of bacilli (bactéridies) in peri-auricular abscesses.*

Although the following two cases, strictly speaking, touch upon points outside the limits of the present paper, I yet report them as a contribution toward the settlement of the question as to the occurrence of microbia in closed collections of pus.

IV. *Fourth observation.*—Prof. X., a famous *savant*, was directed to me by my friends, Drs. Noyes (New York), Dalby (London), and Pratt (Paris). Briefly, the case consisted in a violent exacerbation of a chronic perforating suppuration of the

middle ear. Some days since, the inflammation had extended to the surroundings of the meatus. On my first examination, the latter was found occluded about its middle by inflammatory swelling, and the surrounding cellular tissue, especially above anteriorly, was most intensely inflamed. Soon a colossal abscess formed in the temporal region. When it was opened, odorless, but very turbid, cloudy, unhealthy-looking pus of a pink-violet color was evacuated. It contained, according to microscopic examination, countless bacilli of enormous length. I beg to state here, however, that I had no microscope at hand when I opened the abscess, and that the unusual appearance of the pus induced me to take a sample of it with me for examination at home. On the following days the pus retained the same appearance with like contents. Despite this hiatus in the examination, the bacilli existed undoubtedly in the unopened abscess cavity, and did not possibly form subsequently in the brief time which had elapsed between the opening of the abscess and the examination of the pus. On the one hand, there was absolutely no time for such an enormous development; on the other, if these microphytes had been putrefactive bacteria, micrococci would have developed first, and much later, if at all, the cylindrical forms would have appeared.

A communication of the abscess cavity with the meatus or the drum cavity could not be demonstrated.

The opening and after-treatment of the abscess were done according to Lister's principles (without spray, however). Although during the entire course of the suppuration the excreted masses retained the same unhealthy appearance and contained bacilli, the cavity closed entirely in about two weeks.

The blood of the patient was unfortunately not examined; it must be stated, however, that he was diabetic to a high degree.

V.—*Fifth observation.*—About two months ago, I had the opportunity of observing a case similar to the above, which I shall briefly refer to. The patient was a *concierge*, somewhat anæmic, æt. 35. According to his statement, a swelling had formed in the neighborhood of the left ear, accompanied by pain, increasing until almost unbearable, but without simultaneous symptoms of

inflammation in the ear itself. When I first saw the patient, he was almost raving, owing to the pain which had plagued him for four or five days uninterruptedly. An immense tense swelling extended around the external ear, with the exception of the region below the meatus. Membrana tympani and meatus normal, barring a moderate injection. A free incision evacuated an almost incredible quantity of pink, odorless pus.

Immediate microscopic examination of the pus by means of an excellent Zeis' oil-immersion lens and Abbe's illuminating apparatus shows sparse bacilli; with these are seen stramonium-shaped or stellate red blood-corpuscles.

Immediate cessation of the pain; treatment according to Lister (drainage, etc.), and complete cure in a very short time.

Having reported in this part the result of my study in regard to the presence of schizomycetes in aural affections, I shall proceed hereafter to the interpretation of my results, and see to what extent they are applicable for rational therapeutics, especially in chronic perforating suppuration of the middle ear. The last two observations (IV and V) will not again be referred to, not being of special otological interest, and belonging rather to general bacterio-pathology. I may add here that the treatment I employ consists in a combination of boracic acid and alcohol—either in alternate application or in instillation of an alcoholic solution of boracic acid.

(To be continued.)

ON THE EXFOLIATION OF THE NECROSED SMALL BONES OF THE EAR.

BY DR. OSCAR WOLF, OF FRANKFORT-ON-THE-MAIN.

Translated by JAMES A. SPALDING, M.D., Portland, Maine.

A RECENT and rare case, under my own observation, of exfoliation of the malleus, has led me to look more carefully over my notes of cases of *necrosis of the small bones of the ear*. *Carious necrosis of the small bones of the ear* cannot of course form a special theme for discussion, like, *e. g.*, *otitis media acuta*; for it is almost without exception a secondary phenomenon, associated with caries of the middle ear. Still, it is interesting enough in a pathological and etiological point of view, as well as in the frequency of its appearance and its relations to deafness, to demand some special consideration.

The early literature bearing upon this point is rather bare, in spite of the fact that scarlatina, to which the disease under consideration bears the closest relationship, has found an extraordinary number of interpreters.¹ Rilliet and Barthez² report but two cases of their own of otorrhœa after scarlatina; Underwood-Schulte (1848) mention caries of the petrous bone and exfoliation of the small bones as one of the sequelæ of scarlatina, and Bouchat (1867) speaks of "otitis, with perforation of the *Mt*, loss of the small bones, and caries of the petrous bone." Gerhardt³ (1861),

¹ Compare, Thomas, *Ziemssen's Encyclopædia*, §. Scarlatina. (English translation.)

² *Traité des maladies des enfants*, tome 1, p. 196, 1844.

³ *Lehrbuch der Kinderkrankheiten*, p. 92.

Henning (1864), and West (1865) say about the same thing, while Vogel (1865) enters more deeply into the pathogeny of this complication of scarlatina, and regards the severe affection of the middle ear as a propagation of the diphtheritic process along the mucous membrane of the tubes.

Various works on otology in the last ten years (Yearsley, v. Tröltsch, Moos, Josef Gruber, and Harvey) give minute descriptions of the origin and course of defects in the *Mt*, in suppuration of the middle ear, due to the acute exanthemata, while I myself¹ have described in a series of cases the disturbances of hearing which are noticed after loss of the small bones. It is easy to see why the books on diseases of children do not offer us more material, when we consider that the diagnosis of loss of the small bones demands that practice on the part of the observer which can only be gained in time by the development and extension of scientific otology.

Further on, I shall mention more carefully the *special* cases of necrosis of the small bones, which have been published by v. Tröltsch,² Schwartze,³ Moos,⁴ and more recently by Burkhardt-Merian.⁵

In order to discover the *frequency* of the exfoliation of the small bones, I had to look through my own series of over 6,000 cases, because the literature at my command gave me no hints in this direction. I found 28 cases,⁶ single or double, of loss of the small bones, *i. e.*, 4.3 in every thousand cases, which is suprisingly small, and yet seems perfectly correct, when we consider that only genuine cases have been included in the list. The specialist usually has but few chances of observing the *process of exfoliation*, because energetic and early interference in the acute stage of the disease may prevent this occurrence, or because the process is already ended when the patient

¹ "Sprache und Ohr," p. 107, *et seq.* (1871).

² *Archive f. Ohrenhklde.*, Band vi, Heft 1, p. 55.

³ *Handbuch f. Path. Anat. Klebs, Gehörorgan*, p. 87, *et seq.*

⁴ *Zeitschrift f. Ohrenhklde.*, Band viii, Heft 3, p. 217, *et seq.*

⁵ Volkmann's *Vortraege*, No. 181.

⁶ Only the loss of the malleus and incus is here considered, because the rarer occurrence of exfoliation of the stapes, cannot always be accurately diagnosed during the life of the patient.

is seen at a late stage and only after convalescence from the general febrile affection.

It is, nevertheless, a pleasurable fact to notice in recent years that the most severe types of necrosis have been far rarer than of old,—which proves that specialists have gained a broader knowledge of the significance of an early and scientific interference with the disease. Still, we do not mean to say, that destructive necrosis may not appear even nowadays, in spite of careful and early treatment, when the disease of the ear is due to a malignant form of scarlatinal diphtheria.

Pathogeny and etiology.—Most of these cases of exfoliation are due to the so-called exudative necrosis in scarlatinal diphtheria. It is, *a priori*, easy to understand that just as the diphtheritic exudation causes greater or less structural necrosis of the tonsils, arches of the palate, larynx, and even of the conjunctiva and cornea, so those portions of the tympanum which lie close to the regions most affected by the disease, are likewise affected by the exudation. I fully agree on this point with the opinion of Heydloff¹ and Burkhardt-Merian (*l. c.*, p. 1493), while the fact that I have often found cicatricial contraction, and even closure of the tubes, in cases of loss of the small bones, also indicates that the diphtheritic process is propagated from the pharynx to the tympanum along the tubes.

Still, the diphtheritic exudation alone is not the only cause, as is shown from my catalogue, for there we find, scarlatina, 18 times; scrofula, 2; typhus, 2; measles, 1; periparotitis, 1; diphtheritis, 1; acute tuberculosis, 1; while in 4, no general constitutional affection could be discovered.

Exfoliation of the small bones is very rare without the accompaniment of some constitutional disease, because diminution in the general circulation and defective nutrition of the small bones, must be present, in conjunction with the excessive hyperæmia and congestion arising from the inflammation of the middle ear, in order to lead to acute necrosis. Caries of the tympanum is due, in many cases,

¹ Ueber Ohrenkrankheiten als Folge und Ursachen von Allgemeinkrankheiten. Inaug. Diss., Halle, 1876, p. 8.

solely to the fact that perforation of the *Mt*, and consequent diminution of pressure on the neighboring portions of the tympanum, enclosed as they are in resisting walls, does not appear early enough for the regulated supply of blood to restore the disturbance in the nutrition of the bone.

The *incus alone* was exfoliated six times in the above 28 cases, the *malleus alone* in two cases, which confirms the view already expressed, since the malleus is nourished not only by the vessels of the tympanum through the art. tympanica, but also from the external meatus. For, as is well known, a moderately large branch of the art. auric. profund. runs from the upper wall of the meatus along the handle of the malleus, sends terminal branches into the so-called Gruber's cartilaginous tissue,¹ and thus nourishes the handle from the external surface.²

Twenty-one of the twenty-eight patients lost the small bones of one ear, seven of both ears. *Scarlatina* was the cause of the aural affection in 4.77 per cent. of Yearsley's cases, in 4.35 per cent. of Burkhardt-Merian's (*l. c.*, p. 1492), and in about 4 per cent. of mine. In 18 out of 266 cases under my observation, the malleus and incus were gone, so that 1 in every 14 cases of otitis due to scarlatina, lost the small bones by necrotic exfoliation.

The other patients had greater or less defects in the *Mt*, with or without erosion of the exposed handle of the malleus; in a minority of cases, the *Mt* was preserved, although thickened or cicatricial. In *scarlatinal otitis* we can distinguish three forms of disease, which develop themselves in proportion to the gravity of the constitutional affection, or are influenced in character by the treatment employed.

a. The *sub-acute* form, with sero-mucous secretion, without a necessary perforation of the *Mt*.

b. *Acute otitis media purulenta*, in which perforation of

¹ J. Gruber: *Lehrbuch der Ohrenheilkde.*, p. 138.

² Moos, "On the Blood-vessels of the *Mt* and Handle of the Malleus" (These ARCHIVES, vol. vi, p. 574), shows that some of the branches given off from the distribution of the art. auric. profunda, penetrate Shrapnell's membrane and surround the neck of the malleus, while the main artery of the handle, likewise arising from the art. auric. prof., courses along the handle in the cuticular layer of the *Mt*, and distributes a few branches to the *periosteum* of the lateral portion of the handle and its angles.

the *Mt* is rather due to the pressure exercised by the secretion, than to erosion.

c. The *exudative, necrosing form*, in which either the *Mt* alone undergoes rapid and extensive decay, or is accompanied with a more or less deep-seated caries and necrosis of the bony parts.

The *symptoms and course* of otitis in severe constitutional affections have been so often and so minutely described, that I will pass them aside, and pay special attention to the *exfoliation of the small bones*. As I have already said, the extensive disturbance of nutrition in the acute stage, forms the foundation of the necrosis; the subsequent proliferation of granulations around the diseased ossicle is merely a copy of the same process of exfoliation which we may see in other bones of the body. A disagreeable secretion of pus persists for several months, until some day the exfoliated bone is seen in the water syringed from the ear, or it is extracted by the surgeon. The incus is usually the first to be exfoliated, the malleus generally follows after a short interval.

If the rest of the tympanum is free from carious patches, the secretion diminishes rapidly and loses its fœtid odor. The following case may serve as an example:

Severe scarlatina; otitis media acuta purulenta; abscess of the lungs and empyæma; exfoliation of the necrosed incus and malleus, right; large defect in Mt, left ear.

R. H., æt. 8, January, 1869. Severe scarlatina. On the sixth day he had violent pain in his ears, and soon became so deaf that he could hardly hear any sounds at all. Before the *Mt* became perforated, the boy had chills and pyæmic symptoms, which were followed in a few days by abscess of the lungs and empyæma. The latter was operated upon, but the suppuration continued several months until the fistula closed. The patient was so dangerously affected that his ears could not be treated till May, 1869.

The *right* meatus contained a yellow body which fell out on syringing the ear, and was recognized as the incus, with a carious patch on its larger limb. The malleus was still *in situ*, but dislocated, turned on its long axis. It was easily extracted with the

forceps a few days later. It was slightly eroded on the surface directed toward the outer tympanic wall. The offensive discharge soon ceased; the tympanic mucous membrane became reddish-yellow, but hearing remained very slight. $L v \frac{4}{60}, w \frac{1}{\infty}$, faint.

The *left* ear showed total loss of the *Mt*, and erosion of the end of the handle. The section diminished after a few weeks of treatment, and hearing increased to $L v \frac{1}{60}, w 2''$. The tubes were patent to Politzer's experiment. I have lately seen (after twelve years) the young man, healthy and robust, who came for an opinion as regards his liability to be drawn for military service.

There is no doubt that the pyæmia had depended on the absorption of pus from the tympanum.

The following cases show the terrible destruction which scarlatinal diphtheria and diphtheritis may cause.

Scarlatina with diphtheritis; exfoliation of the necrosed small bones of both ears, and of the posterior wall of the left meatus; facial paralysis; closure of the tubes; labyrinthine disease.

Carl N., æt. 13, June, 1876. The patient had suffered from scarlatinal diphtheria four months before, becoming deaf on the sixth day of his illness. He subsequently had an offensive discharge from his ears, right facial paralysis, and nephritis in the third week of the disease.

At my first examination I saw the *right* malleus lying transversely across the field of vision, and turned on its axis. It was easily removed with the forceps, and its head found extensively destroyed by caries. The incus had already been exfoliated. A large polypus, containing a bit of necrosed bone from the posterior wall of the meatus was removed from the *left* ear. Both small bones had already been destroyed. *Both tubes had become consolidated* with large cicatrices on the arcades and at the posterior wall of the pharynx. The hearing was totally lost.

The necrosis in this case had rapidly attacked the facial canal, and caused the paralysis of this nerve. The diphtheritic exudation seems to have greatly interfered with the function of the labyrinth also, for the large c° and a° forks could only be felt by bone-conduction from the vertex of the head, while perception of speech was destroyed.

Diphtheria; necrotic destruction of the mucous membrane of the mouth and pharynx; closure of the tubes; loss of the right eye, and of the small bones in both ears.

Barbara B., æt. 9, was attacked with diphtheria in June, 1877, and came under my treatment in June, 1879. She lost her two younger sisters from diphtheria on the tenth and twelfth days respectively, of the disease. The child had deep, cord-like cicatrices at the angles of her mouth, a sharply-defined defect in the left palatal arch, which looks if it had been punched out, while the right eye has been lost, and lies sunken and atrophic in the orbit. Both ears are filled with cheesy masses, the tympanic mucous membrane is covered with granulations, the small bones are lost, and both tubes are closed. The father tells me that "small bones" dropped out of the patient's ears in the eighth or ninth week of the disease. Hearing: *Right*, $w \frac{1}{\infty}$; $l v 8'$; *Left*, $l. v. 2'$.

All of the cases of exfoliation of the necrosed small bones which I have noted in my own practice, or collected from literature, have depended upon some acute constitutional affection. I have never heard of but one case of a *primary or slowly progressive constitutional affection, terminating with exfoliation of the small bones*, unless an acute constitutional disease, with acute otitis media had preceded it, although a few *autopsies* have favored the view of a *primary ostitis* of the small bones.

This single case of my own is interesting in a pathological, as well as in a physiological, point of view.

Primary ostitis of the malleus, with exfoliation of the same after necrosis. Recovery with relatively good hearing.

Mrs. G., æt. 30, previously well, but delicate and pale, came under my charge December 1, 1880. Her father, æt. 56, has tabes dorsalis; her mother, carcinoma of the uterus. The patient has noticed an irritating and offensive discharge from her *left* ear for five months, together with a feeling of fulness and moderate deafness. She has had no pain nor roaring.

Hearing: *Left*, $w 1 \text{ cm.}$; $w v 25 \text{ cm.}$ Forks, c° , a° , and a' are heard distinctly by aerial conduction, but weaker than in the *right* ear. On the other hand, they are heard louder in the *left* by bone-

conduction from the vertex. Hearing is much increased in the left ear by bone-conduction from the temples and mastoid process. The right ear is normal.

The left meatus contains a thin and offensive secretion. Only the lower and thickened portion of the *left Mt* is visible, while the upper portion is covered with granulations, which project from the region of Shrapnell's membrane. Air enters the tubes with difficulty by Politzer's method, but subsequently the patient's head feels clearer. The sharp spoon was used to remove the granulations, and while so doing I felt rough bone. The hollow of the spoon contained numerous black particles of carious bone. The hemorrhage was slight. Boracic acid was subsequently applied. The operation was repeated on the sixth day, owing to the reappearance of the granulations. While operating I pushed the spoon backward and upward to scrape off the carious edge of the tympanic ring, and felt a loose bit of bone. But after syringing the ear I was not a little surprised to see the exfoliated and carious malleus lying in the basin. The end of the handle was missing. The operation caused but little pain, and the hearing was but slightly altered. The secretion soon diminished, and on the eighth day after exfoliation of the malleus the meatus was dry and the patient very cheerful, for she heard better, while the feeling of fullness had disappeared. On the fourteenth day after the operation, Dec. 21st, the following interesting condition was discovered:

Mt wholly concave, tendinous, gray, and thickened, but *quite movable*, while the region of the handle was distinctly indicated by a vessel which ran varicosely and tortuously over the umbo. A projection of bone (recognizable as such by the sound) in the neighborhood of the short process gave the whole bottom of the meatus the very same appearance that one sees every day in chronic catarrh of the middle ear, with its concave and thickened *Mt*, foreshortened handle, and projecting short process. The only difference was a deep, sickle-shaped cicatrix in the Rivinian notch, which closed over a gap in the osseous tissues.

The further treatment consisted in the use of Politzer's bag, after which the hearing always increased in a moderate degree. At the end of the sixth week the hearing was as follows:

T. F. louder, *left*, from the vertex; *w* 5 cm.; *wv* 6 cm.; Politzer's acoumeter 40 cm. I would here call attention to the fact that the patient was very intelligent and attentive, and that in my repeated tests of the hearing for the voice and watch, I always closed

her right ear hermetically with a plug of wadding covered with wax.

Examination with the *consonants* showed the remarkable fact that the explosive sounds, *b*, *k*, *t*, which possess a relatively slight strength of tone,¹ were heard proportionally further than the hissing sounds, which are usually the most audible. The *f* sound was heard worst of all. The relative *b* sound was substituted for *m*. The letter *r* (with the end of the tongue), if uttered alone, was heard at 2 *m*; the explosives *b*, *k*, and *t* at 4.5 *m*; the hissing sound as 6 *m*; while with the normal ear *b* is heard at 5 *m*; *r*, 12 *m*; *k* and *t*, 18 *m*; *sch*, 60 *m*. Words beginning with *t*, *r*, *d*, and broad *a* were heard, when whispered, at 6 *m*, while those beginning with *f* were only heard close at hand, owing to the weak perception of the *f* sound.

Remarks.—These tests show that the human *Mt* makes wide excursions when exposed to the action of the explosive sounds,² for it is only in this way that we can explain their extraordinary good perception. The greater excursion of the *Mt*, when the explosive sound was spoken, in connection with the associated increase of aerial pressure, caused the membrane to approach the incus, and in this way allowed a more exact transmission to the oval window. The diminished adaptation of the apparatus of hearing, dependent upon the loss of the malleus, could best be compensated for, in case of the explosive sounds, when the centre of the *Mt* approached the incus.

The tests also prove the noteworthy fact that hearing may be very good, even for weak tones, in spite of the loss of the malleus.

I think the picture of the *Mt*, at the last time I saw the patient, was in the following way: After loss of the malleus the concave *Mt* sank backward upon the anterior spur of the incus, which counterfeited the short process. The handle was likewise counterfeited by the vessel still remaining in the periosteum.³

¹ Compare "Sprache und Ohr," page 71.

² Compare, also, Blake. These ARCHIVES, vol. vii, page 457.

³ The only similar case of which I know is the one by Moos, already mentioned (these ARCHIVES, vol. ix, page 30), in which the necrosis was due to pharyngeal diphtheritis. Moos says: "After closure of the perforations the

The case which I have here reported does not offer much assistance in solving the existence of a *primary otitis or periostitis of the small bones of the ear*, as raised by v. Tröltsch¹ and Schwartz², and recently discussed by J. Gruber.³ We simply see the bone gradually necrose, and then a recovery after exfoliation of the necrosed portion of bone, in a case without severe pain and not preceded by an acute otitis media. In a casual point of view, it may be repeated that the father of the patient suffers from tabes, the mother from carcinoma of the uterus, so that the patient may inherit a diminished vascular resistance.

region of the manubrium was occupied by a very deceptive, white, narrow streak, while the region of the short process was denoted by a slight projection." The hearing was much less than in my case, owing to extensive changes in the tympanum.

¹ *Archiv f. Otol.*, Band vi, Heft 1, in which he speaks of finding the body of the incus in a state of *ostitis*, in a patient who had died of typhus fever.

² Klebs: *Handb. d. patholo. Anat.*—*Path. Anat. d. Ohres*. Schwartz says: "There is no question about the appearance of *primary otitis*."

³ *Lehrbuch*, page 495, describes a specimen from a deaf-mute: "The incus was dislocated from both hammer and stirrup, and found lying at the entrance into the mastoid cells." The *Mt* and malleus were nearly normal.

ON THE USE OF RESORCIN IN AURAL PATIENTS.

BY DR. E. D. ROSSI, OF ROME.

Translated by JAMES A. SPALDING, M.D., of Portland, Maine.

(*Preliminary paper.*)

SINCE March, 1880, I have experimented and am still experimenting with resorcin, a parabioxybenzole which was discovered by Hlasiwetz and Barth in 1864, and introduced into medico-chirurgical practice in 1877 by Andeer.

Leaving to future practice to discover the more especial indications for the use of this remedy in otology, I will merely say at this point that I have so far used it in more than 200 cases of otitis med. purul. chron., and feel myself justified in claiming that *no* remedy at my disposal has ever given me such substantial results in this obstinate affection as resorcin. Even in those cases in which caustics had been used in vain *for months*, resorcin has brought about a perfect cure, and sometimes in an astonishingly brief time, after five or six applications.

This remedy is soluble in alcohol, glycerin, and water. I have used it *pure*, or in aqueous, or alcoholic solution, 4:100.

I have never noticed any toxic symptoms, or severe irritation, or any signs of the caustic action which have been attributed to this drug. In one case the gums were irritated as during mercurial inunction. Vomiting was also noticed once.

It seems to me that the *great therapeutical value* of resorcin depends upon its antiseptic properties, so that I feel justified in placing it side by side with phenic and salicylic acid, inasmuch as it is more easily borne than these latter remedies, and especially in the middle ear.

From this point of view I have undertaken numerous experiments, in order to decide upon the action which the remedy under consideration exercises upon the microscopic organisms contained in pus from the ears.

I propose in due season to publish the experimental as well as the practical results which I have obtained.

MINOR OTOLOGICAL CONTRIBUTIONS.

BY DR. G. BRUNNER, OF ZURICH.

Translated by JAMES A. SPALDING, M.D., of Portland, Maine.

I. *Total deafness on both sides after a fall against the forehead. Diagnosis: Fracture of the base of the skull.*

K. B., a master-joiner, æt. 52, and in perfect health, made a misstep, fell down some cellar stairs (6 or 8 steps), and struck his forehead against a wall. He became suddenly deaf, and had to be carried to bed. He soon felt better, and was about to leave his bed on the following day, when he became so dizzy that he had to make an effort to prevent himself from falling. The vertigo lasted three days, accompanied with occasional vomiting, and then gradually disappeared. The patient had bled slightly from his mouth soon after the fall; *on the other hand, a clear fluid fell drop by drop from his nose during the first two days after the accident.*

The patient says, that for the first few days he could still hear a little, but that later both ears became totally deaf, so that he could no longer hear his own voice. *Subjective noises* of various sorts were also observed, *e. g.*, a violent roaring and rushing in the head, like the noise of a turbine wheel, intermingled with sharp, clear tones like those of a music-box, and, in the early period after the injury, *complete melodies, as if played on a hand-organ.*

When I first saw the patient, four weeks later (Sept. 12, 1880), his general health was again perfect, the vertigo had disappeared, and was not even produced by rapid revolution of his head. When he looked suddenly upward, he would occasionally feel somewhat dizzy. The deafness, however, had not improved in the slightest degree. The patient could not hear his own voice,

nor the loudest shouting, nor the report of a musket, nor bells. Still, there were a few days, during the treatment (Sep. 24th), when he declared that he could hear (not merely feel) the large fork (*E*) from the vertex of his head. But he could not tell precisely whether he felt or heard the staff-shaped fork (*C*), or the prismatic fork (*C'*) when held in the same locality.

The subjective noises had decreased in violence, but were still very annoying. In the right ear they seemed like roaring; in the left, ringing like bells, sometimes like the cackling of geese. A yelling, screeching tone occasionally vibrated through the middle of his head.

The *Mtt* showed no trace of injury: they were gray and dull. There was slight injection around the left malleus, as well as about the anterior-superior segment of the right *Mt*. This condition, however, evidently depended on the recent instillation of various ear lotions.

The treatment from which I had but slight hopes, and which I only undertook at the urgent request of the patient, was fruitless, and, so far as I know, total deafness still persists. I first resorted to vigorous local abstraction of blood, and then to potassium iodide for a long time. In the meanwhile, the constant current was used by Brenner's method (up to 14 Siemen's-Daniell's elements, with $\frac{30}{100}$ Siemen's units of resistance), to relieve the subjective sensations of sound. The anode was placed in the meatus, the cathode in the corresponding hand. The following observations were made:

(a) Both ears responded to the exciting currents, *Ca O* and *A O*, with humming or hissing; in the first two sessions in the formula of simple hyperæsthesia.

(b) A violent paradoxical reaction appeared at the first two sittings; *i. e.*, with *Ca O* the permanent humming in the left ear suddenly ceased, and crossed over into the right ear, according to the following formula:

LEFT EAR.		RIGHT EAR NOT ARMED.	
14 elements,	30 <i>Ca S</i> , humming.		—
14 "	30 <i>Ca D</i> , " continuous.		—
14 "	30 <i>Ca O</i> ,	humming loud.	
14 "	30 <i>A S</i> ,	"	
14 "	30 <i>A D</i> ,	" continuous	
14 "	30 <i>A O</i> , humming.		—

The paradoxical humming in the right ear persisted after the session, while the previous subjective noises disappeared for a while.

(c) The favorable influence of the constant current in this case, as in many others, diminished during the later sessions. In the beginning of the treatment the subjective noises would become very faint for fully twenty-four hours, and give rise to delusive hopes. This transitory improvement lessened more and more with subsequent sittings, so that the result of the case fell far below our early *expectations*.

(d) Finally, I would mention, that a humming noise was heard when breaking off conduction from the anode in the neighborhood of 40-30 units, as I have often before observed. It is evident that the current then left the labyrinth, or became so weak that it was like *AO*; on slipping from 30 to 0, no further *AO* reaction was noticed.

The most important point in this case is to decide whether the auditory nerve was excited in the (injured) labyrinth, or further toward the central organ of hearing. The first view presupposes that the nerves of the labyrinth can still be excited by the electric current, when they no longer or but slightly respond to waves of sound.

In conclusion, one or two remarks:

The flow of clear liquid from the patient's nose for two successive days, together with the total deafness which appeared directly after the accident, seems plain enough in a diagnostic point of view. The case is one of those rare ones of recovery from a fracture of the base of the skull.

We should notice particularly that excessive *vertigo* was only present in the three first days, during which period the central organ of the semicircular canals was probably incapable of performing its functions. This observation agrees with the one so often made by other medical men, *that vertigo is not produced by the failure of the semicircular canals to perform their function, but by the active irritation, the shock, which the injury to the canals in question exercises upon the central organ.* (Urbantschitsch, p. 505.)

It has even been proved that exfoliation of the semicir-

cular canals (as well as of the rest of the labyrinth) may take place without symptoms of vertigo, while on the other hand the sudden entrance of air into the middle ear, or the removal, or even the touching, of a granulation lying near the round window, may give rise to the most violent vertigo, and even to (transitory) paralysis of the extremities.¹

At this point I would mention that Prof. Huguenin thinks that *disturbances in equilibrium are always dependent on a lesion of the vermiform process of the cerebellum.* (*Corresbl. f. Schweiz. Aerzte.*, 1880, p. 717.) "Prof. Huguenin then exhibited a patient, aged 46, in whom a hemorrhage in the cerebellum had been diagnosed. The man was suddenly attacked with vertigo, vomiting, and pain in the occiput. The latter symptom still persists, as well as vertigo, whenever the patient lifts his head. When he walks, he staggers like a drunken man. Pulse 48-56. Prof. H. thought that it was very interesting and new in his experience, that disturbance of the sense of equilibrium could always be referred to a lesion of the vermiform process of the cerebellum. He also explained in the following manner how the removal of the semicircular canals leads to the same variety of disturbances. *Fibres pass from the ganglion cells at the origin of the auditory nerve to the vermiform process, and probably accompany the auditory nerve to the semicircular canals. Other fibres pass with the corpora restiformia from the vermiform process to the medulla spinalis.*"

The *subjective perception of melodies* was only noticed in the early days. Prof Hermann thinks that this perception is located in the central organ of hearing in the cerebrum.² We should, therefore, have to assume, under such a view, that the violent injury of the labyrinth exerted an influence as far as the auditory centre in the cerebrum, where it caused a transitory (two days in our case) irritation.

II. Concussion of the labyrinth after a blow from a cane

¹ Urbantschitsch, *ubi supra*. Also Brunner: "Auditory Vertigo." These ARCHIVES, vol. ii, part 2, p. 293. These later observations are especially interesting as concerns the relations of the acoustic nerve to the motor tracts.

² These ARCHIVES, vol. ix, p. 75.

in the neighborhood of the ear. Transitory and partial deafness, with pain, for low tones.

Mr. C., master-locksmith, æt. 59, received on the previous night a severe blow near the left ear from a cane. The locality of the injury is still slightly swollen and discolored. The patient complains of *diminution of hearing, persistent and annoying noises in the ear*, as well as slight pain about the ear and jaw. Vertigo is absent. The subjective sensation of sound, which consisted in the morning of a continuous high tone, has now given way (afternoon) to a deep tone, like that from a church bell.

Examination of the auditory meatus and *Mt*, is negative, with exception of a diffuse opacity in both *Mtt*. The hearing, which had previously been very useful, considering the age and occupation of the patient, is now considerably reduced for both watch and voice, in the left ear. Whispering is not heard on this side, while only an occasional word in a loud conversational tone, close to the ear, can be guessed at, rather than distinctly heard. *W*, left, $\frac{\text{contact}}{800}$; right, $\frac{8}{800}$ cm. Examination with the piano shows that in the left ear *the four highest notes, e^a—a^a can no longer be heard; notes from e^a down to f¹ are heard fairly well, while from the middle of the middle octave downward, all the notes cause a sensation of pain in the left ear. The lower the tones, the more painful the sensation. They also sound dissonant.* The right ear is normal in this respect. The tuning-fork is not heard any louder in the left ear by bone-conduction. The patient recovered in ten days without any other treatment than complete rest.

There is no need of argument to show that this case was not a mere affection of the middle ear. However, the seat of the lesion in the labyrinth, rather than nearer the auditory centres, seems especially indicated by the nature of the injury to which the labyrinth being more exposed was more directly liable. At the same time, this fact takes away all foothold for the view that the irritation of the central organ was conducted along the auditory tracts. It is worthy of mention that the paræsthesia (subjective perception of sounds) and hyperæsthesia affected the same region of the scalp.

It would have been particularly interesting to discover whether this was also the case in the forenoon, *i. e.*, whether

a hyperæsthesia of the high octaves, corresponding to the subjective sensation of high tones, was present in the forenoon, so that *while the hyperæsthesia and paræsthesia fell downward in the scale until afternoon, they were transformed into paresis in the high octaves.*

We are further to note that the upper octaves, which almost invariably suffer the easiest, were also first affected in this case. If we could confirm this condition in other similar cases, we might get additional proof that the upper octaves react most sensitively, not only to vibrations of sound, but to coarse mechanical irritation.¹

In a similar case observed by Moos,² a patient who was struck on the ear with the fist, became for a short time deaf to bass tones.

III.—*Intrinsic noises in the ear from muscular action.*

A. *Muscular noises in the ear due to mental agitation.*—I lately read in a novel the following passage descriptive of overpowering joy at an unexpected meeting after a long separation: "His heart was too full for utterance, and *there was a noise in his ears like the roaring of waves and the flapping of wings.*" This acute observation on the part of a non-professional writer struck me exceedingly. For the expression, "like the flapping of wings," is a very precise definition (as I can confirm from my own experience) of that entotic noise which is occasionally perceived in moments of great mental agitation, and is undoubtedly due to involuntary and convulsive muscular contractions, accompanied with simultaneous quivering of the facial muscles (angle of the mouth, nostrils). It is a *deep, rough, flapping noise*, just as if the *beating of a large pair of wings* were heard passing by the ear. This beating evidently corresponds in duration to the individual (tetanic) contractions of the muscles concerned, and, as it always seems to me, as if the tubes were opened to the entrance of air isochronously with the beating. I feel obliged to refer the noise chiefly to the tubal

¹ Concussion of the ear by sudden variations of pressure in the air, is also regularly accompanied by a high subjective tone in the ear. See these ARCHIVES, vol. ix, p. 56, *et seq.*

² *Virchow's Archiv*, Bd. xxxi, p. 125.

muscles. Perhaps the tensor tymp., or the stapedius also participates, but I have never felt any especial sensation of tension, or movement of the *Mt*, during the noise, so that I must confess that the latter appears too intense to be referred to the tiny stapedius alone. The simultaneous contraction of the facial muscles is also doubtful, because their distance would prevent the production of so loud a noise in the ears.

I would here recall the following obscure case from my own practice :

A delicate girl, æt. 13, suddenly perceived, without any assignable cause, a loud noise in her left ear, "as if a bird were flying by." Deafness in this ear also followed without any other symptoms. When I saw the patient on the next day, her hearing was already restored, and there was nothing abnormal in the ear.

Was this perhaps a case of spasm of the intrinsic or tubal muscles? The flapping character of the entotic roaring, which I regard as pathognomonic, seems to favor such a view. But, on the other hand, how can we explain the deafness, which was indeed of brief duration, but by no means momentary!

More about muscular noises may be found in Herman : *Handbuch der Physiologie*, 1 Bd., 1 Abth., pag. 48, *et seq.* During every voluntary contraction the muscle receives about $19\frac{1}{2}$ irritations per second from the central organ. Every continuous, at all events every voluntary, muscular contraction is to be regarded as a tetanus. But the audible muscular noise has from 32-36 vibrations per second—contra *C*, contra *D* (Helmholtz). Hence we do not hear the fundamental tone, but the first over-tone of the real muscular noise. Or, as Helmholtz recently assumes, the audible muscular noise has nothing to do with the vibratory period of the muscle, but is a resonating tone of the ear itself, produced by these irregular concussions. In order to hear the muscular noise we should rest our elbows on a table, fix the forefingers firmly in the ears, and then, *e.g.*, contract the thumbs. We at once hear a deep, rattling noise. In my opinion, however, other noises, such as that of the current of blood, and the rubbing produced by the fingers in the meatus, are here at work. This much, at all

events, seems assured, and it is valuable in a diagnostic point of view, that the muscular noise does not rise above contra *d* (37 vibrations).

There are two other intrinsic muscular noises which are to be distinguished from the flapping noise just described.

B. The well-known cracking (or snapping) tubal noise, which, as is generally and correctly assumed, originates when the tube is opened by the separation of the adherent walls. Like other persons, I can produce this sound voluntarily, either in the right or left tube, and rhythmically at pleasure, with or without going through with a simultaneous motion of swallowing, *but not without causing the uvula and velum to move rapidly upward*. This noise is short, abrupt, lies in a higher octave than the one previously described, and has another particular characteristic, which depends upon the degree of moisture or adhesiveness of the walls of the tube. Thus, I have noticed in myself that, after the use of the nasal douche, or at the commencement of a nasal catarrh, the noise has a sharper tone, like the tearing of paper. I have also noticed once or twice during a cold that I could not for a while produce the snapping noise in my left ear, the tube of which cannot be easily inflated by Valsalva's experiment. In this case the muscular contraction was not powerful enough to separate the tubal walls.

C. A hammering, knocking noise in the ear, which is sometimes perceived in chronic catarrh of the middle ear, and also depends, as I learn from self-observation as well as on others, on muscular action; *i. e.*, on *involuntary* (fibrillar) muscular contractions. This noise, as can often be proved by auscultation, consists of short, muffled beats, like the dull tone of a child's drum, which follow one another very rapidly (faster than the beat of the pulse), and in irregular rhythm. A couple of beats usually follow one another swiftly, in the rhythm of a trochee or dactyl. They sometimes sound like a short firing in file, then comes a pause. The whole is repeated after shorter or longer intervals, but is usually transitory, does not last days or even hours, and bears great resemblance to contractions of the muscles about the eyelids

and face. I think it quite probable that this phenomenon *is also based upon some such fibrillar quivering either of the tubal or intrinsic muscles*, and that it is favored by the chronic affection of the mucous membrane of the muscles, just as tremor of the eyelids is sometimes noticed in chronic blepharitis.

I will not here presume to decide whether these tremulous movements appertain to the intrinsic or tubal muscles. But this much seems evident, that the noise in question is not really a muscular noise, but one indirectly produced by muscular action, similar to the snapping tubal noise. Perhaps it originates in the same way as the latter; *i. e.*, involuntary contractions in the tubal muscles lead to an extremely rapid but slight separation of the tubal walls; or, slight contractions of the intrinsic muscles produce a rubbing noise against the small bones or on the *Mt*.

I call this noise, the *drumming entotic noise*. This term distinguishes it from the real entotic muscular sound, and from the snapping tubal sound. Characteristic of it, together with the above-described peculiarity of its tone, is the fact, that it always appears involuntarily, and that it is repeated several times, but not in the regular rhythm of the pulsating noises. It is not particularly annoying to the patient, and has no special prognostic value.

Under this head we may include the following interesting case; noticing, however, that the noise was extremely annoying, so that not merely slight fibrillar muscular contractions, but more intense clonic spasms were at work.

Madame W., æt. 62, had suffered for many years in her youth with a discharge from her right ear. The left ear was always considered sound. I found that the otorrhœa had stopped, leaving a partial defect of the *Mt*, accompanied with considerable deafness. The left *Mt* was slightly opaque (ot. med. cat. chr.), but the hearing was good considering the patient's age. Right, $w, \frac{\text{contact}}{500} \text{ cm.}$ Left, $w, \frac{70}{500} \text{ cm.}$ She had no trouble at all in hearing conversation.

In March, 1878, the patient suddenly felt, one night without any previous cause, a *sudden knocking noise in the left ear*. It was faster than the pulse, and ceased after half an hour, without af-

fecting the hearing. On the next night, the noise was heard again just like the beat of a drum, and so on for fourteen nights, about half an hour after the patient had gone to bed. The noise often lasted all night long, but sometimes ceased about three in the morning. At daybreak it disappeared. At the end of fourteen days the "beating of drums" changed—at night again—into a "hammering like a mill-clapper," at first slow, then more rapidly, quicker than the pulse, and so violently that the patient became greatly alarmed and lit a lamp. The knocking lasted another six weeks, only at night, with one exception, when it lasted twenty-four hours. The hammering was sometimes interrupted by a noise as if a large bumblebee were flying near the ear. The patient was not aware of other noises, such as whistling, hissing, ringing, or roaring, but sometimes at the beginning of the knocking noise, or while it was present, it seemed as if there were a peculiar drawing sensation from the ear down toward the neck, so that she often asked her husband (who was a physician), whether there was not some connection between the ear and the neck. During this period the patient felt obliged to keep to her bed for five weeks. The physicians declared that the disease was a nervous affection, due to over-exertion at household work. Besides this, the patient had always suffered from a slight trembling or nodding of her head, which still continues.

Eight weeks after its appearance, the knocking ceased as suddenly as it had come on; after beginning in a most violent manner at seven o'clock in the evening, it suddenly disappeared at nine o'clock while the patient was nervously walking to and fro in her chamber, and did not return for four weeks. It then reappeared for eight evenings in succession, but not so violently, nor did it last all night long and then disappear completely. Two months later, after the patient had suddenly lost her husband, the knocking reappeared for four evenings in succession. On the fourth evening, when it was most distressing, it instantaneously disappeared, and up to the last time when I saw the case, three weeks later, it had not again been perceived. I do not know whether or not it has again appeared. *The hearing had not been affected in the slightest degree by these repeated attacks.*

The distinct intermittent character, and, above all, the sudden appearance and cessation of this knocking noise, seem to me to indicate a neurosis. The drawing sensation from the

ear to the throat, so forcibly insisted upon by the patient, would also indicate a clonic spasm of the tensor tympani, or of the tubal muscles. The rapidity of the intermittent contractions reminds one of muscular tremor. Whether the spasm proceeded from the central organ (as seems probable to me), or whether it originated in the periphery, must be left in doubt. The advanced age and nervous disposition of the patient—genuine hysteria was entirely absent—may be suggested as the predisposing causes. In the same way, the simultaneous tremor of the head is to be taken into consideration.

I do not think that this particular noise is really muscular, but that, as in the previous case, it depends upon some movement of the tubal walls, or of the chain of bones, or of the *Mt*, due to the action of the muscles. On the other hand, I am inclined to regard that peculiar sensation "as if a large bumblebee had flown close in front of the ear," as a muscular noise dependent upon longer contractions, which took place at intervals between the short vibrations.

Hardly any one will agree with the view that the knocking noise was not intrinsic, but dependent on paræsthesia of the auditory nerve or its central organs, although I will not deny that knocking noises, like the beating of a drum, may occur in a purely subjective manner. In the foregoing case, however, there are many symptoms which seem to negative such a view. If I had been able to examine the patient during an attack, an inspection of the *Mt*, or of the soft palate, or orifices of the tubes, might have yielded more satisfactory data.

ON DISEASES OF THE EAR IN LOCOMOTIVE ENGINEERS AND FIREMEN.

BY DR. D. SCHWABACH AND DR. H. POLLNOW, OF BERLIN.

Translated by JAMES A. SPALDING, M. D., Portland, Maine.

I.*

AFTER Moos had read his paper "On the diseases of the ear in locomotive engineers and firemen," etc., before the second International Otological Congress at Milan in 1880 (these ARCHIVES, vol. ix, page 319), it was *unanimously* voted that the Italian Ministry be requested "to send a petition to the various European governments asking the railroad authorities to cause the hearing of these employés to be tested from time to time by competent physicians." As a result of this petition, the Lower Silesian R. R. Co. has lately had the hearing of 160 of its employés at Berlin tested by Drs. Lehfelddt and Pollnow. These two gentlemen discovered 34 men who were more or less deaf, and transferred them to me for a more precise test of their hearing, as well as to determine the objective conditions of their ears, and for eventual treatment. The hearing was tested with a cylinder watch of 1.25 *m.* normal distance, with the common *c*¹ tuning-fork placed on the forehead to test the bone-conduction, and finally with the whispered voice.¹ In some of the cases in which the whispered voice is marked as heard at 6.50 *m.*, the hearing was really higher

* Dr. D. Schwabach.

¹ Abbreviations.—*H*, for hearing; *W*, for watch; *T F*, for tuning-fork; *B C*, for bone-conduction; *W V*, for whispered voice.—*Transl.*

than that, but could not be measured further owing to the limited size of the room in which the examination was made.¹

The results of these tests show, as Moos declared, that *locomotive engineers and firemen, by virtue of their occupation, sooner or later suffer from an affection of the ear, with diminution of hearing, usually on both sides.* The influence of occupation is proved by the fact that *the number of those who are deaf increases according to the length of service.* The percentage of affections of the ear is quite noticeable; in 160 employés we find 34 affected with deafness. From these we exclude one in whom the removal of a plug of cerumen restored the hearing to the normal amount, and so find about 20 per cent. of deafness, which is about the same (25 per cent.) as discovered by Dr. Lent in his examinations for diseases of the respiratory tracts in the same class of employés.

The number of those affected in hearing during their early years of service is quite small. Amongst 59 employés who had served about five years, only 5 (8.50 per cent.) were deaf even in a slight degree. *W V* still heard a considerable distance; *W* nearly normal except in two cases in which the hearing was relieved by treatment with the air douche; *B C* generally perfect.

The number of those who were hard of hearing, as well as the degree of deafness, was much more unfavorable in the case of those employés who had been on locomotive duty for more than five years. Of the 160 examined, 68 had been employed from six to fifteen years. Of the latter, 14 were deaf (20.5 per cent.).

In some of these cases, hearing for the watch had already diminished *a great deal*. In two cases, both ears, *W*, $\frac{1}{\infty}$; in one case, on one side only, *W*, $\frac{1}{\infty}$. In the other cases, *W*, from $\frac{2}{128}$ cm. to $\frac{30}{128}$ cm. *W V* was still pretty well heard in this series of cases; in the two in which the watch was only heard on contact, hearing for *W V* was decidedly lessened,

¹ The results of this examination are given in a synopsis of the 34 cases, arranged in the form of a table, with supplementary remarks, which are, however, so detailed that they have been omitted from the translation, as it is believed, without essential loss to the reader.—*Ed.*

but greatly improved in one by the repeated application of the air douche. In some cases in which W , $\frac{2}{1\frac{1}{2}}$ cm. and in one, W , $\frac{1}{\infty}$, WV could still be heard in one or both ears at 5-6.5 m. BC for the watch was good in six cases, slight in three, and absent in two. The test was doubtful in three cases. TF was heard in eleven cases, the same on both sides; in three, louder in one ear, which was always the more defective.

The defect in hearing, the number of cases, and the degree of deafness increased still more noticeably in those employés of from sixteen to twenty-five years of service. Of these, 28 were tested and 19 found deaf—35 per cent. In four of these, W , $\frac{1}{\infty}$ only, viz., two in both ears and two in one ear, while in the other, W , $\frac{2}{1\frac{1}{2}}$; W , $\frac{2.0}{1\frac{1}{2}}$ cm. Bone-conduction for W was not perceived in three cases, which we must probably refer to the age of the employés, 50 and 53 years. In three it was weak; in one, only perceived through the temples, and in two the answers were indefinite. In only one was it good through the temples as well as through the mastoid processes. TF was heard by bone-conduction, in four cases, well in both ears; in one case only, loudest in the better ear, in two, in the more defective ear. *The hearing for the voice was not so much lessened in these ten cases as for the watch.* In only one case was it reduced to contact in one ear, 60 cm. in the other. In all the others, WV from 30 cm. to 6.50 m., with considerable variations between the two ears.

The defects in hearing were most noticeable in those employés who had been on locomotive duty for more than twenty-five years. Of five in this class, four were very deaf (80 per cent.). In one case, W , 0, both ears, by aerial or bone-conduction; TF by bone-conduction doubtful. In two cases, W , $\frac{1}{\infty}$, but not by bone-conduction, although the fork was still heard by bone-conduction. In one case, W , on one side, $\frac{5}{1\frac{1}{2}}$ cm.; on the other, contact. By bone-conduction in this case, W in the better ear, not heard in the worse ear; TF the same. These four men were all over 50 years of age, so that an affection of the labyrinth could not be accurately diagnosticated from the tests by bone-conduction.

Three of these four men were also very deaf for the voice. In one of them only a loud voice could be distinguished close to the ear; in the other ear, a whisper. In another, the hearing was 3 m. on one side, 6.50 m. on the other.

Nine patients complained of *subjective noises*. In one case, in a man only one year in the service, the noises were evidently due to an acute catarrh of the middle ear, and disappeared after Politzer's inflation. The other eight cases occurred in men who had been in service fourteen to twenty-seven years. The roaring had lasted for several years in three cases; in the others it was only transitory.

The subjective noises in one case consisted of a feeling of knocking in the right ear, which diminished whenever pressure was made over the mastoid process, and then gradually disappeared.

The *objective symptoms* in most of the cases consisted in the usual changes in the *Mt*, observed in the sclerosive form of otitis media catarrhalis chronica. Symptoms of chronic pharyngeal catarrh were also occasionally noticed. The latter, in conjunction with nasal catarrh, as is often observed to be the case, seems to indicate a common causal connection between the disease of the middle ear and the catarrhal affection of the nose and pharynx. It is by no means surprising that the duties of locomotive engineers and firemen especially predispose to such catarrhal affections, when we consider their exposure to all sorts and changes of weather, and above all, as Moos suggests, to the action of noxious gases. We can also easily comprehend how the loud noises about the engine, and the shrill tone of the steam-whistle, may cause disturbances of hearing, when we reflect that locksmiths, blacksmiths, and other workmen whose trade exposes them to the influence of loud sounds and noises, often suffer from disturbances of hearing most of which are to be referred to a direct affection of the labyrinth. It seems, therefore, remarkable to me that only three of these cases could presumably be referred to such a cause.

After a violent storm on his regular trip, one man experienced roaring in his right ear, headache, and a feeling of

dizziness. His hearing also soon became affected. The result of the test by bone-conduction was in consonance with these symptoms, for the tuning-fork was heard better in the better ear from all parts of the head, and even from the mastoid process of the worse ear. The excessive degree of deafness with negative condition in the *Mt*, in another case in which the hearing had diminished rapidly in the last two years, indicated a primary affection of the auditory nerve, even if we refer the results of the test of hearing by bone-conduction to the advanced age (57) of the patient. The negative objective symptoms in a third case, in conjunction with the tests of hearing, indicate a primary, although slight, affection of the labyrinth. Moos was unable to demonstrate any *direct* labyrinthine affection in the ten cases which he reported.

We may imagine a secondary affection of the labyrinth from the sclerosive form of ot. med. cat. chron., in six of our cases in which the watch was either not heard at all, or only slightly by bone-conduction. Still, the fact that in all these cases the tuning-fork could still be heard by bone-conduction, would seem to prove that the affection of the labyrinth was but slight.

Although these facts prove without the shadow of a doubt that *disturbances of hearing are very prevalent amongst locomotive engineers and firemen, and that they increase in frequency and intensity in proportion to the years of service*, it must be a matter of surprise that a large number of these employés assured me that they had never noticed any great decrease in hearing, while those who had noticed this decrease for a longer or shorter time declared that it did not in the least incapacitate them for active service. We may indeed place implicit reliance upon what these men said, when we consider that their diminution in hearing generally referred to the perception of fine tones, such as the ticking of a watch, while a whispered voice was heard, in many cases, if not at a normal, at least at a considerable, distance. Thus, in 33 cases, 14 heard *W V* at 6.50 *m.*, 6 in both ears, 7 in one ear; in only 8 cases was *W V* heard at less than 1 *m.*, 3 in both ears, 5 on

one side only. The shrill note of the conductor's whistle was heard by all the employes the whole length of the station platform. These facts lead us now to the question, whether the second of Moos' conclusions, that the disturbances of hearing in locomotive engineers and firemen may endanger the travelling public, is correct or not. In order to determine this question we must first discover what sounds or noises on and outside the engine these employes have to hear in order to insure an accurate performance of their duties.

II.*

The following acoustic signals, prescribed by the German railroads, are the ones which we have here to consider.

1. The conductor's signal, by a mouth-whistle, for departure of a train (— —).

2. The signal, by the same whistle, for stopping (U U U).

3 and 4. By the mouth-whistle, or horn, in shifting: "Go ahead" (—), and "Back" (— —).

5. The torpedo-signal (detonating or fulminating signal).

6. The signal of alarm by pulling a rope which is connected with the steam-whistle.

Nos. 1, 3, and 4 are only used when the engine is standing still.

2 is to be used, "when the engineer has just set the train in motion, and it is to be stopped. Further, this signal is to be given during the journey by the employes on the train, to signify danger and to bring the train to a stop."

Signals 5 and 6 are only used when the train is in motion.

If we examine these signals with a view to discovering their importance, so far as concerns security of travel, we see that it is only by a failure to hear those which are prescribed for use while the train is in motion, that danger can arise.

* Dr. Pollnow.

In order to test these signals in various ways, I have made repeated journeys on the engine, the first of which was on March 15, 1881, from Berlin to Frankfort-on-the-Oder, by express.

The questions which I wished to answer, were :

1. What can any one with normal hearing hear, when the train is going at full speed ? and,
2. How defective in hearing can any one be, and yet hear signals 5 and 6 ?

The day was calm and sunny, and the upper layers of ground were already free from frost, and once more soft, so that every thing was suitable for hearing sounds of every variety. The engine was a large coupled one with its smoke-stack turned forward. The noise which it made while running was not above the average, as I was informed by the road-master, who made the journey in company with me. We had previously agreed with the conductor that he should, during the trip, give various signals (No. 2) with his whistle from the coupe which he occupied at the rear of the train, and that he should always note the precise time at which they were made. A telegraphic message had also been sent ahead, to lay a torpedo signal on the track.

After the journey had begun, we first noticed that the noise made by the engine was so loud, that even one with perfect hearing could only understand what was spoken when the words were uttered in a loud tone close to his ear ; moreover, that the noise made by the train could not be heard at all. The first extraordinary noise was the detonation of the torpedo signal, of whose presence the fireman and engineer of course knew nothing. The engineer could hear, $W_{\frac{5}{125}}$ cm., and $W V$; *Left*, 5 m, *Right*, 6.5 m. But at the instant of the explosion, he cut off steam, and began to stop the engine. After being told, however, that the torpedo signal had only been laid for the sake of experiment, he opened the valves, and the journey proceeded. "I thought that a tire had loosened," said the engineer, evidently more at ease, while at the same time I learned what sort of a noise a loosened tire makes. After a long pause,

during which the attention of both engineer and fireman had been diverted from the next experiment by various remarks, I pulled the signal-cord unexpectedly, and in such a way that the engineer could not possibly see my movements. At the very first shriek of the steam-whistle, the engineer began to stop the train.

The trip was afterward continued to Frankfort without any especial incident.

But where were all the conductor's signals in the meanwhile. The conductor had made a great many, but none of us on the engine (all hearing perfectly, except the engineer) had heard a single one, although we had repeatedly listened for them, and some, as we afterward learned, had been made while the train was running slowly.

On the return trip to Berlin, we had a chance to observe another unusual noise. The buffer, between the engine and tender, got dry, and caused a moderately loud squeaking noise, which was at once perceived by the engineer (*W V*, right, 5 *m*; left, 3 *m*), correctly located, and obviated by oiling at the nearest stopping-place.

The result of our investigations was as follows:

1. The torpedo-signal (or a similar sound, like the breaking of a tire), the steam-whistle signal, and the lesser noise of the dry buffer, were accurately perceived by two engineers whose hearing for slight noises was diminished to $\frac{1}{25}$ — $\frac{1}{80}$ respectively, and for whispered voice to about $\frac{3}{4}$ of the normal amount.

2. No one, even with perfect hearing, can hear the conductor's whistle, or any noise in the rear of the engine, while the train is in motion.

The experiment with the torpedo-signal was afterward tried in the case of others whose hearing was greatly diminished for *W* ($\frac{5}{125}$ cm.). But these employes heard the signal promptly.

Finally, another employé, who heard *W* $\frac{1}{60}$, *W V* 0.5 *m.* — 2.5 *m.*, was tested with the mouth-whistle. He could hear it very plainly at 60 *m*, and said that the distance could have been doubled without any danger of his not hearing it.

After all, the importance of the mouth-whistle, so far as concerns any danger to traffic or life from any inability on the part of the engineer to hear it, is very trifling, for signals 1 and 2 are either given when the train is standing still, or directly after it has been put in motion. At that time, however, the conductor usually stands close to the engine, and only total deafness could hinder the engineer from hearing them. Our experiments have also shown us the uselessness of signal 2 as a danger signal, a circumstance which is fortunately of no serious importance, because in every train at least the first car must be connected with the steam-whistle by the alarm cord, so that the signal in question (No. 2) would only come into use in case of the very improbable accident of breakage of the cord.

The shifting signals 3 and 4 are always accompanied with the visible hand- or arm-signals. The engineer and shifter never rely upon the audible signals alone, for their trustworthiness is often greatly interfered with by the unfavorable direction of the wind, as well as by the numerous secondary noises about the railroad station.

If we sum up the results of our observations and suppositions, we come to the general conclusion *that no great claims need be made upon the hearing of locomotive engineers or firemen, since even a considerable diminution of hearing in these employés does not endanger the security of railroads.*

Grateful as we may be to Moos for drawing attention to this topic, and interesting as it is in a scientific point of view, to study the influence of the hearing of railroad employés on their capacity for active duty, *the practical value of the subject to the railroad authorities is of but slight importance*, and we may as well coincide with the views of the railroad commissioners:

That locomotive engineers and firemen hear sufficiently well, so long as they can follow a conversation carried on in the ordinary tone of voice.

THE AMERICAN OTOLOGICAL SOCIETY.

THE FOURTEENTH ANNUAL MEETING, HELD IN NEWPORT,
RHODE ISLAND, JULY 26, 1881.

(REPORTED BY WESLEY M. CARPENTER, M.D.)

Morning Session.

The Society met in the Masonic Building, at 10.30 A. M., and was called to order by the President, Dr. J. Orne Green, of Boston, Mass.

The President appointed as

BUSINESS COMMITTEE.

Drs. D. B. St. John Roosa, H. D. Noyes, of New York, and J. S. Prout, of Brooklyn.

The Treasurer's report was read, and referred to Drs. C. J. Blake, of Boston, and C. H. Burnett, of Philadelphia, as

AUDITING COMMITTEE.

The following gentlemen were nominated for membership :

Dr. Gorham Bacon, of New York ; proposed by Drs. Samuel Sexton and C. H. Burnett. Dr. Geo. C. Harlan, of Philadelphia ; proposed by Drs. C. H. Burnett and D. B. St. John Roosa. Dr. A. Alt, of St. Louis ; proposed by Drs. John Green and C. J. Kipp. Dr. S. C. Ayres, of Cincinnati ; proposed by Drs. S. Theobald and H. D. Noyes.

The Committee on Membership further reported in favor of the election of Drs. W. H. Carmalt, of New Haven, Conn. ; F. B. Loring, of Washington, D. C. ; S. B. St. John, of Hartford, Conn. ; and R. A. Reeve, of Toronto, Can. ; and they were all elected by ballot.

The following gentlemen were made

MEMBERS BY INVITATION :

Drs. Gorham Bacon and W. M. Carpenter, of New York, and U. H. Brown, of Syracuse, N. Y.

The Business Committee announced as the first paper, one by Dr. S. THEOBALD, of Baltimore, Md., entitled, "Suggestions regarding the treatment of suppurative otitis."

The therapeutic agent to which especial attention was directed consisted of a powder composed of equal parts of boracic acid and oxide of zinc, which he had used freely by insufflation. In some cases he had used boracic acid and alum, and in a very few the oxide of zinc alone. The action of the acid and oxide of zinc was mild and non-irritating, so much so that it could be used in the painful stage of otitis media. Carefully syringe the ear, and introduce the powder freely with an insufflator. Dr. Theobald reported eight cases in which the proposed remedy had been used with marked benefit, and while he did not claim that it was infallible, he recommended it as a valuable combination in the treatment of that class of cases.

In reply to a question by Dr. Blake, of Boston, Dr. Theobald said he thought the powder could be blown into the upper portion of the tympanic cavity.

Dr. H. D. NOYES, of New York, had used with advantage equal parts of tannin and boracic acid, and regarded the combination as much better than either substance, when used alone.

Dr. SAMUEL SEXTON, of New York, had not found the treatment recommended by Dr. Theobald to be satisfactory in acute cases, but in the more chronic cases it had given him satisfactory results, and especially so when combined with calendula, 25 or 50 per cent. He had included the latter because of its repeated healing properties.

Dr. C. J. KIPP, of Newark, N. J., had abstained from using powdered combinations, because he regarded it as good surgery to give vent to accumulations of pus.

Dr. C. H. BURNETT, of Philadelphia, had usually used pure boracic acid, sometimes combined with powdered lysopodium, and with satisfactory results. But he had employed it in only sufficient quantity to cover the walls after cleansing with a syringe, and rather as a dryer in the later stages of muco-purulent affections.

The PRESIDENT had used boracic acid with satisfactory results, especially in dispensary and hospital practice. He had employed it in large quantities, filling the meatus one eighth or one quarter full, because it was so readily soluble that it had not prevented ready flow of the discharge. To be serviceable, it must be in the form of an impalpable powder, and Mawson's pulverized boracic acid was the only reliable article which he had been able to obtain.

Dr. JOHN GREEN, of St. Louis, had used the oxide of zinc extensively, and had come to regard it as a remedy which certainly could be used with positive advantage.

Dr. A. H. BUCK, of New York, directed attention to Reynders' powder-blower as being a very convenient and durable instrument. The tube was so slender that it could be readily introduced into the meatus.

The PRESIDENT had found it to be advantageous to use boracic acid very freely in *profuse otorrhœa*; and he referred to a case of double chronic otorrhœa, in which, within three weeks, the discharge ceased, the large granulations shrivelled, and the progress continued to be favorable without other treatment.

Dr. SEXTON referred to one case in which the discharge was retained, in consequence of packing the meatus with boracic acid. He thought it to be well to caution the patient that upon the slightest continuous pain the ear should be carefully cleansed. He also had frequently seen granulations disappear under the use of this remedy. He preferred to introduce the powder through a speculum, and push it well into the meatus with cotton.

Dr. D. B. ST. JOHN ROOSA, of New York, read a paper on the "Value of operations in which the tympanic membrane is incised," for which see this number of these ARCHIVES.

Dr. C. J. BLAKE, of Boston, favored the small incision, and for some time had used a simple needle. In cases marked by severe pain, considerable congestion at the upper part of the membrana tympani, bulging of the membrane by compressed air, he had made early what might be called a "dry puncture" at the point of greatest prominence; and, in several cases, a sharp hiss had been caused by the escape of the air, the pain had in a measure been relieved, and usually the opening had been utilized within twenty-four hours for free serous discharge with corresponding relief.

Dr. BUCK thought that Dr. Roosa's statement concerning oper-

ations upon the membrana tympani was a very fair one ; and that no single statement could reflect the average sentiment of otologists better than that made. He agreed with it in all essential points.

Dr. C. J. KIPP, of Newark, N. J., fully agreed with the general sentiment expressed by Dr. Roosa. Formerly he performed the operation very frequently, so frequently at least that Dr. Sexton had once referred to his report as evidence of its abuse. Latterly he had resorted to it only in acute cases. In acute inflammation of the middle ear, with scarlet fever, he resorted to the incision only when there was a vascular appearance, with bulging of the membrane.

In the class of cases, called by Dr. Buck inflammation of Shrapnell's membrane, he invariably made an incision, and always with benefit, although the quantity of fluid which escaped might be small.

Dr. H. D. NOYES agreed with the general statement made by Dr. Roosa. He preferred, however, to make a free opening in acute cases, because of the tendency on the part of the membrane to rapid closure, and thus prevent a suitable escape of the fluid. He had performed the operation almost exclusively in acute cases ; and in order to make the incision with accuracy, a mirror should be used.

With reference to aural inflammation with scarlet fever, he had reached nearly the same opinion as that expressed by Dr. Kipp. If there was a great deal of pain, considerable resistance of the membrane, with or without bulging, he had found it to be advantageous to make a free incision. On the other hand, in cases in which ulceration occurred rapidly, and speedy egress would be afforded to the fluid by natural processes, an incision was detrimental.

Dr. J. S. PROUT, of Brooklyn, several years ago attempted to make a permanent opening in the drum-head, in a case of chronic non-suppurating inflammation, and in that case the improvement in hearing was very marked for some months, but gradually the opening closed, and finally the hearing was no better than if the operation had not been performed.

In a second case he performed the same operation, and the result was a permanent suppurative inflammation ; and in view of that result he had not attempted to apply the method of treatment since.

In the acute inflammatory conditions, when there was accumulation of fluid, bulging of the membrane, and the case was especially painful, he made an incision in the drum-head.

Dr. C. H. BURNETT heartily subscribed to what Dr. Roosa had formulated; but would add that he always incised when he thought there was any fluid behind the membrane. The gentleness of the operation he regarded as very important; and his custom had been to simply stab the membrane first, making the smallest possible opening, and if then the fluid did not flow freely, the puncture could be slightly enlarged. He also thought, with Dr. Prout, that it was not wise to wait too long, for dangerous results might follow, and besides there was advantage in having the surgeon select the position for the opening.

Dr. SEXTON remarked that he had not had any experience in operations upon the drum-head for improving impaired sense of hearing. He had not, moreover, been in the habit of frequently perforating the membrana tympani for the liberation of fluids. He did not regard the mere existence of fluid, either serous or purulent, in the tympanic cavity as a condition always calling for perforation of the membrane. If he was to be guided by any single condition, he would say that if the membrane was upon the point of giving way from ulceration, he should not wait, but neither bulging of the membrane, nor the neuralgic pains, which are so frequent a symptom in these acute cases, would necessarily induce him to operate, for he believed that extension of the inflammation to the brain depended more upon continuity of structure than upon the presence of fluids in the tympanum. He had been in the habit of prescribing internal remedies for the relief of the inflammatory process, and the one mostly relied upon perhaps was the sulphide of calcium, in doses of from $\frac{1}{10}$ to $\frac{1}{2}$ a grain. For the relief of pain, he did not rely entirely upon the calcium, but gave in addition some preparation of aconite in small doses frequently repeated. The use of leeches he had long since discarded.

Dr. NOYES said that in performing the operation in acute cases he always used an anæsthetic; ether in the young subject, and in the adult patient either ether or chloroform, administered only sufficiently to produce primary anæsthesia.

Dr. PROUT said that when Dr. Matthewson, nine years ago, incised the drum-head in one of his ears, he did not find it to be so painful as he had anticipated. Blood and mucus escaped, and he was certain that it would not have been so well to have waited.

Dr. NOYES remarked that he incised the drum-head in one of Prof. B's ears, and the doctor said that he would not submit to the operation again without an anæsthetic.

Dr. E. W. BARTLETT, of Milwaukee, Wis., assented to the general statement made by Dr. Roosa. The only operation which he performed was paracentesis, and, if the knife was well-pointed and perfectly sharp, so that it would pass through kid without pricking at all, it was painless. He thought that it was safer to make the opening too early than too late, and if left to be made by nature it was apt to be in the wrong place.

Dr. BLAKE had not used anæsthetics in this operation.

Dr. BUCK had used anæsthetics only very rarely when performing the operation upon adults, and could not recall a case occurring in children from one to three years in which he had found them necessary.

Dr. A. MATTHEWSON, of Brooklyn, had not had a favorable experience in operating upon the drum-head in non-suppurating cases. In the acute suppurative affection, if the pain did not subside within a short time, he resorted to puncture of the membrane.

Dr. BURNETT had not employed anæsthetics. In acute cases his patients had not complained of pain from the operation, but in some of the cases of so-called chronic catarrh, incision of the drum-head had given rise to considerable pain.

The PRESIDENT remarked that the testimony seemed to be so universally in favor of incising or puncturing the drum-head in acute cases of accumulation of fluid within the tympanic cavity, he would ask if any one favored the older operations, which Dr. Roosa had condemned in chronic non-suppurative affections.

Dr. THEOBALD agreed with the general inadvisability of incising the drum-head except for the purpose of promoting the escape of some accumulation. In many cases of chronic inflammation in which there was fluid in the tympanic cavity, the accumulation could be gotten rid of without making an incision; and in such cases he thought that the catheter was more useful than Politzer's method.

To check the inflammation in acute cases he recommended instillations, three or four times a day, of a solution of atropia; four grains to the ounce of water.

Dr. BUCK thought all present were so perfectly in accord with the general statement made by Dr. Roosa concerning the cutting

of tendons, opening the membrane with acids, etc., that no one could wish to prolong the discussion.

Dr. D. B. ST. JOHN ROOSA, of New York, then read a paper on "The tuning-fork in diagnosis."

The following propositions were laid down as having been verified by the author's practice:

1. If one ear be normal as to hearing power, and the other abnormal, and a vibrating tuning-fork be placed upon the vertex or the teeth, if its sound be intensified in the ear whose hearing power is diminished, there is disease of the external or middle ear, but no lesion of the labyrinth or nerve.

2. If, under the same conditions of a sound ear on one side, while the hearing power of the other is impaired, the tuning-fork be not heard better in the worse ear, even if the meatus be stopped by the finger or the like, there is disease of the labyrinth, the acoustic nerve, or brain.

3. If the vibrating tuning-fork be heard better on the mastoid than when placed in front of the meatus, there is disease predominantly of the middle ear.

4. If the tuning-fork be heard better through the air than through the bones, there being impairment of hearing, the disease which gives rise to this symptom is situated in the brain, nerve, or labyrinth.

Dr. BLAKE, of Boston, had found it necessary to use a number of tuning-forks of different letters for purposes of testing; for, in some cases the patient did not hear one tone while he might hear another.

Dr. ROOSA's second proposition brought up the question of conduction of vibration through fluids, which was the particular question in view in a series of experiments which he had not yet completed. But the results of the experiments, so far, went to show that a considerable impairment attended the transmission of vibrations through fluid in a solid or closed space. It was therefore possible to imagine a condition in which as the result of intra-labyrinthian pressure, the vibrations of the organ of Corti would be impaired.

Dr. JOHN GREEN, of St. Louis, suggested that the head was a positive resonator, and that the power of conduction varied in the heads of different patients.

Dr. BLAKE said that from experiments made by himself six

years ago, he could say that there was very nearly an octave difference in the resonant power of the mastoid cavity in man. In different animals there was also a marked difference.

The President, Dr. J. ORNE GREEN, of Boston, then read a paper, entitled "Removal of a foreign body by disarticulation of the auricle."

A pistol had been fired into the ear on the 11th, and the patient died on the 23d of the same month. The bullet was removed early, and in the manner indicated, and was in three pieces. Dr. Green commented upon the criticism of the operation made by Dr. S. D. Gross, of Philadelphia, who had performed the same operation, and he was surprised at Dr. Gross' criticism.

Dr. ROOSA stated that he, like Dr. Green, was surprised to read, years ago, the statement by Professor Gross, that the suggestion of an operation for detachment of the auricle was absurd, and a recent remark by a reviewer in the *American Journal of Otology* somewhat to the same effect. He had performed the operation some years ago, in a case in which he was assisted by Dr. Rankin, of Newport, and in Dr. Ely's case of operation for deformity of the auricles (see these ARCHIVES, vol. x, p. 97) he had also found the operation entirely feasible, and that it afforded a good view of the tympanic cavity.

The Society adjourned to meet at 4 P.M.

Afternoon Session.

The Society was called to order at 4 P.M. by the President, and the minutes of the previous session were read and approved.

The first paper was read by Dr. C. H. BURNETT, of Philadelphia, and entitled "Malignant growth in the naso-pharynx, with early aural symptoms."

The aural symptoms were due to obstruction of the pharyngeal extremities of the Eustachian tubes. Both drum cavities filled twice with fluid. No autopsy could be obtained.

Dr. ROOSA asked Dr. Burnett if he thought that the improper use of the Turkish baths mentioned in the clinical history was what led to the development of the primary disease.

Dr. BURNETT replied that there was a connection between the two in point of time, and the patient, an intelligent physician, believed that the relation was one of cause and effect. Dr. Burnett's own opinion was that Turkish baths, improperly used, might give rise to naso-pharyngeal catarrh.

Dr. ROOSA remarked that he has recommended such baths for patients who were constantly taking cold, but has not seen much benefit from the remedy.

Dr. C. J. KIPP, of Newark, N. J., then read a paper containing the history of a case of "Epithelioma of the middle ear." See this number of these ARCHIVES.

"Selection of test-words according to their logographic value," was the title of an oral communication made by Dr. C. J. BLAKE, of Boston, who had been experimenting with the view to obtaining as accurate a means as possible for testing hearing. Search for any single method or instrument, however, was like the search for the philosopher's stone. The object of his experiments had been to arrange consonant sounds according to their force value, according to the intensity of tone produced by the amount of air expelled, and he had found that those in the English language could be classified and arranged quite readily into words which would represent intensity of tone. For example, the word *cat* could be heard by the greatest number of persons; the word *house* by 40, and the word *hand* by 56 per cent., etc. A large variety of words was most important, and he had made a list sufficiently extensive so that different selections could be made upon each occasion of testing.

It was discussed by Dr. Burnett.

Dr. A. H. BUCK, of New York, then read a paper entitled, "Sudden and complete loss of hearing during an attack of mumps."

The paper contained the histories of two cases, with remarks. The first was that of a girl who on the third day of an attack of mumps had sharp pain in the ears, and on the following day she discovered that she had lost the power of hearing. The second case was that of a man in whom deafness developed without pain during an attack of mumps. In both cases each parotid region was equally affected, but in one only one ear was involved. Dr. Buck believed that the origin of the deafness was in the labyrinth in both these cases. (The paper may be found in the *American Journal of Otology*, vol. iii, p. 209.)

Dr. ROOSA remarked that he had seen sufficient of such cases to make him anxious that no one in whom he was interested should get the mumps and then get ear trouble. He had seen the second case reported by Dr. Buck, and concluded that the nerve was in a

state of inflammation and that atrophy of its fibres would follow. He hoped that Dr. Buck would remove his book from the category in which he had placed it, as giving no account of deafness from mumps. Parotitis as a cause of disease of the ear had been mentioned in his first edition, while in the later ones the subject was quite fully discussed. He would be glad to have his colleague, Dr. Sexton, who had but little faith in the existence of disease of the acoustic nerve, give the situation of the lesion that produced the deafness thus suddenly developed in the course of an attack of mumps.

Dr. SEXTON was much obliged to his colleague for his kind invitation, but thought that so far as theories went he must give to him the palm. Not having had the opportunity to examine the cases reported by Dr. Buck, he did not feel qualified to give an opinion concerning them. However, he was willing to abide by the diagnosis made and the opinions expressed by both Dr. Buck and Dr. Roosa.

Dr. BURNETT asked for the evidence of the labyrinthian disease.

Dr. BUCK replied that Vogel's statement had led him to that conclusion. It was evident that the auditory nerve was affected; whether in the labyrinth, or in the cranial cavity, or in the medulla oblongata, he would not be positive; but, with such anatomical relations as existed, it would be natural to assume that the inflammatory trouble existed in the cochlea or labyrinth rather than in more remote regions.

Dr. BURNETT's experience had led him to the conclusion that the lesion in this class of cases was, in the middle ear, catarrhal in character and produced by congestion about the parotid gland.

The PRESIDENT had been satisfied, for a number of years, that in a certain percentage of cases, middle-ear changes developed after labyrinthian trouble had existed for some time.

Dr. ROOSA remarked that he had already alluded to that point in discussing deafness caused by cerebro-spinal meningitis. He had seen cases in which there were no changes, appreciable by him, in the drum-head, and yet the deafness was absolute, but with the lapse of time came changes affecting the membrana tympani, which were marked. He thought that slight injustice was being done to the subject by not investigating the labyrinth as ophthalmologists did the retina and the optic nerve, and he be-

lieved that in the light of recent investigations such as those of Moos and Steinbrügge, it would soon be possible to diagnosticate acoustic neuritis and atrophy.

Dr. KIPP thought the fact was often overlooked that a great many cases existed in which hearing was perfect, and yet the drum-head presented morbid appearances. Besides, we should reason somewhat from analogy; there were but few cases of acute inflammation of the middle ear in which deafness was developed with such rapidity as had been mentioned.

Dr. BURNETT said that he had had opportunity to examine a very large number of cases of deafness following cerebro-spinal meningitis, and was certain that in very many of them the drum-heads were in good condition, notwithstanding the deafness was of long standing.

The PRESIDENT said that he did not wish to have any general conclusion drawn from his statement, as it was meant to be simply that, in some cases at least, secondary changes involving the tympanic cavity followed labyrinthian disease.

The paper was further discussed by Drs. John Green, Prout, Kipp, Roosa, and Sexton.

Dr. BUCK, of New York, then read a brief paper containing the history of a case of "Small vascular tumor of the membrana tympani." He regarded the occurrence of such tumors in that region as very rare.

Dr. SAMUEL SEXTON, of New York, exhibited "A flexible Eustachian catheter."

(For a complete description of the instrument with illustrations, see the *Medical Record*, vol. xx, p. 82.)

The Business Committee reported the following

NOMINATIONS FOR OFFICERS

for the ensuing year :

For President, Dr. J. Orne Green, of Boston.

For Vice-President, Dr. J. S. Prout, of Brooklyn.

For Secretary and Treasurer, Dr. J. J. B. Vermyne, of New Bedford.

For Committee on Publication, Drs. J. J. B. Vermyne, C. J. Blake, and J. Orne Green.

For Committee on Membership, Drs. John Green, of St. Louis ;

C. H. Burnett, of Philadelphia ; and H. G. Miller, of Providence.

The report of the Committee was unanimously adopted.

The Society then adjourned to meet at 10.30 A. M. on the day previous to the first day of the annual meeting of the American Ophthalmological Society, in 1882, and in the same place.

REPORT ON THE PROGRESS OF OTOLOGY FOR THE FIRST HALF OF THE YEAR 1881.

Translated by ISIDOR FURST, of New York.

I.—NORMAL AND PATHOLOGICAL ANATOMY OF THE ORGAN OF HEARING.

BY H. STEINBRÜGGE, OF HEIDELBERG.

1. CHARLES J. KIPP. On branchial fistulæ at the external ear. *Transact. Amer. Otological Society*, 1880.
2. J. ORNE GREEN. The foramina of the mastoid emissary veins. *Amer. Jour. of Otol.*, vol. iii, No. 2, April, 1881.
3. C. HASSE. Bemerkungen über die Lymphbahnen des inneren Ohres. [Remarks on the lymph-channels of the internal ear.] *Arch. f. Ohrenheilk.*, Bd. 17, H. 3.
4. CH. SEDGWICH MINOT. Some recent investigations of the histology of the scala media cochleæ. *Amer. Journ. of Otol.*, vol. iii, No. 2.
5. L. KATZ, of Berlin. Zur Casuistik des Cholesteatoms des Schläfenbeins. Tod durch Sinusthrombose. [Cholesteatoma of the temporal bone. Death by thrombosis of the sinus.] *Berlin. klin. Wochenschr.*, No. 12, 1881.
6. JAMES A. ADAMS. On certain anatomical relations between abscess of the brain and aural disease. *Glasgow Med. Fourn.*, vol. xv, No. 6, June, 1881.

i. KIPP observed in 6 persons (4 males, 2 females) at the helix, about 1 cm. above the upper margin of the tragus, fistula-like channels, 3 to 10 mm. in length, which secreted a milky fluid. In three the anomaly existed on both sides, and in a like number

the channel terminated in a cyst. No other malformations were connected therewith. In all cases the anomaly had existed from birth. Two cases occurred in sisters, but no other heredity could be demonstrated. By retention of the contents, the cysts enlarged, and could be reduced only after repeated incision and application of caustics.

2. ORNE GREEN examined in 16 skulls the mastoid foramina, in respect to their presence, size, and position. They were present 29 times, varied in diameter between 5 and 0.5 mm., occurred regularly at the posterior limit of the mastoid process, but at variable height, namely, 20 times in a line drawn from the external auditory meatus above the centre of the mastoid process, twice above, six times below it, and once at the base of the skull.

3. HASSE confirms the fact regarding the endolymphatic spaces, that the aquæductus vestibuli in man and mammals ends in a cul-de-sac in the dura mater, and conjectures that its communication with the subarachnoidal space takes place solely by means of the arachnoidal sheaths enveloping the nerves and vessels; that a renewal of the endolymph can occur besides by diffusion from the epi- or endural serous channels. The perilymphatic spaces communicate in part by means of the dura sheath of the acoustic nerve with the subdural cavity; the main efferent channel for the perilymph, however, is formed by the aqueduct of the cochlea. The latter is said not to lead into the subdural space; the author supposes, basing on his examinations of the labyrinth in the four lower classes of vertebrates, that, besides the dura investiture, it contains a membranous canal which connects both with the subarachnoid space and with a lymphatic vessel accompanying the jugular vein.

4. The present communications contain the results of Böttcher's histo-genetic investigations of the labyrinth from the year 1869, as well as those of Lavdowsky's examinations of the acoustic terminal apparatus of mammals, published in 1876 in the *Archiv für microscopische Anatomie*, and therefore contain nothing new to the reader.

5. The author reports three cases of cholesteatoma of the petrous bone.

(1.) A man, æt. 22, suffering from bilateral chronic otitis media purulenta. Right fistulous tract in the mastoid process. Daily rigors; icterus; after six days, death, with symptoms of sepsis.

Autopsy: Multiple pulmonary abscesses, tumor of the spleen, in the right transverse sinus thrombi which extend into the jugular vein as far as the middle of the neck. Fistulous tract leading from the posterior wall of the auditory meatus into the mastoid antrum; the latter dilated, with smooth walls, and filled with masses of cholesteatoma. Perforation the size of a bean at the posterior surface of the pyramid. Communication of the fistulous tract in the mastoid process with the sigmoid fossa. The ordinary microscopic appearances. At the places exposed to the air, the tumorous masses were pigmented by numerous yellow round bodies.

(2.) A boy, æt. 13, with caries of the left mastoid process. Incision above it, on account of great oedematous swelling. Death after three days from septicæmia. Cholesteatoma of the mastoid process, and of the drum cavity. Perforation at the posterior surface of the petrous bone. Sinus thrombosis and basilar meningitis. Narrowing of the left auditory canal.

(3.) A man, æt. 30, suffering from otorrhœa of the right side. Granulation in the auditory meatus, fistula at its posterior wall, drum destroyed. Paralysis of the right facial. Agonizing pain, vertigo, sopor. Under ice applications, improvement in the course of four weeks. Complete deafness, right; paralysis of the facial has disappeared. Nine months later, death from right pleuritis, starting from caries of the lower ribs. Right temporal bone carious, and filled with masses of cholesteatoma. *No traces of any preceding affection in the brain and dura mater.* The author holds, therefore, that the former threatening symptoms were due to an inflammation of the labyrinthine structures.

6. The author endeavors to prove that although purulent otitis media is more frequent in childhood than in adult age, cerebral abscesses due to the aural affection are more common in the latter. The causes are ascribed to anatomical conditions, and the author regarding the veins as the exclusive channels for the conduction of septic materials, his corollary is briefly the following: In the child the cells of the mastoid process are less developed than in the adult; the mastoideo-squamous suture, however, is still open, hence any pus possibly present is more usually evacuated externally. On the other hand, in the adult, the suture is closed, but the wall separating the mastoid cells from the transverse sinus is thin, and thus morbid processes are here more easily transferred to the vessel-walls of the sinus. In this way thrombi

are produced, which again cause stasis in the other sinuses, especially in the sinus petrosus superioris. The cerebral veins have no valves; the blood-current is, therefore, reversed, thus facilitating the conduction of septic matter from the petrous bone to the brain. Small veins extending from the dura directly into the brain substance of the occipital lobes and the cerebellum, effect this transference.

II.—PHYSIOLOGY OF THE ORGAN OF HEARING AND PHYSIOLOGICAL ACOUSTICS.

BY OSCAR WOLF, OF FRANKFORT-ON-THE-MAIN.

1. BENNO BAGINSKY, Berlin. Ueber die Folgen von Drucksteigerung in der Paukenhöhle, und die Function der Bogengänge. [On the consequences of increased pressure in the drum cavity, and the function of the semicircular canals.] *Archiv für Anatomie und Physiologie*, by His, Braune, and Du Bois-Reymond. Physiological Department, 1881, Heft 3, 35 pp.
2. VICTOR URBANTSCHITSCH, Vienna. Zur Lehre von der Schallempfindung. [The perception of sound.]
3. DENNERT, Berlin. Zur Analyse des Gehörorgans durch Töne in ihrer Bedeutung für dasselbe. [The analysis of the organ of hearing by tones in their importance thereto.] *Berliner klin. Wochenschr.*, 1881, No. 18. Reprint, 22 pp.
4. EUGEN BLEULER and KARL LEHMANN. Zwangsmässige Lichtempfindungen durch Schall und verwandte Erscheinungen auf dem Gebiete der anderen Sinnesempfindungen. [Sensations of light induced by sound, and kindred phenomena in the other organs of special sense.]

1. BAGINSKY was incited to the present investigations by observing a dog, which for several months had exhibited distortion of the head and vertigo. Dissection of the animal had shown that the drum cavity of the affected side was tensely filled with watery fluid. In the labyrinth and in the brain no coarser, microscopically visible lesions could be found.

For the purpose of *increasing the pressure*, injections of different liquids of varying temperature were made into the *drum cavity*, after perforation of the membrana tympani, of the animals experi-

mented upon. The author remarks *a priori* that during such injections fluids easily escape into the trachea through the tubes, thus exposing the animals to the danger of asphyxia; therefore, "the trachea must be compressed or tracheotomy performed previously." The reporter cannot refrain from expressing some disapprobation of such utilization of the results of the dissection. An animal whose trachea is compressed is at any rate in a state of cerebral hyperæmia; moreover, even tracheotomy does not in the least prevent the flow of liquids into the bronchi when fluids are forcibly driven through the tubes into the naso-pharyngeal space. As the author does not state anything about the *post-mortem* appearance of the lungs, simply remarking that tracheotomized animals die early, pneumonia or asphyxia is not excluded as cause of death. It is well known that in dissections of that nature the brain and meninges are often found hyperæmic and œdematous.

As regards the observations, the animals experimented upon showed nystagmus and turning of the head (toward the side operated upon); these symptoms were more pronounced after the injection of cold or chemically different liquids than after that of warm or chemically indifferent fluids. The forcing of air under great pressure through the tubes was likewise followed by rolling of the eyes, nystagmus, exophthalmus, and, finally, death. The author explains the entrance of fluids or air-bubbles into the subdural space by the tearing of the membranes of the fenestræ, after which the fluid reached the arachnoid space by way of the aquæductus cochleæ.

Moreover, to disprove the doctrine formulated by Goltz, according to which the semicircular canals should be considered to some extent as peripheral organs of the so-called static sense (Breuer), Baginsky destroyed the respective parts of the labyrinth in dogs and pigeons, and reaches the conclusion "*that an isolated injury of the semicircular canals without a reflex effect on the brain is impossible*," and that, therefore, the succeeding disturbances of equilibrium must be referred to cerebral lesions (extravasations of blood, draining away of cerebro-spinal fluid, purulent meningitis). Unfortunately the reporter cannot coincide with this deduction of the author. For, on the one hand, Baginsky's own statement—that, after section of the horizontal canals, a horizontal, after division of the posterior vertical canals, a vertical pendulousness of the head occurred—still speaks strongly *in favor* of Goltz's doctrine; on the other hand, Spamer,¹ who divided his experiments, for the pur-

¹ Compare the reference in these ARCHIVES.

pose of demonstrating the result, into "*pura*" (such cases in which no kind of cerebral lesion was found at the autopsy) and "*imperfect*" ones, has furnished the proof that it is certainly possible to experiment with the semicircular canals without causing cerebral lesions. Spamer attaches but little importance to the invariably minimal escape of cerebro-spinal fluid through the vestibular aqueduct, as it occurs only exceptionally and can produce nothing but quite transient symptoms. Moreover, Spamer found that the simple isolated irritation of a semicircular canal produced symptoms of vertigo and nystagmus. Finally, the reporter is of opinion that the "pathological experience" (according to which, despite necrotic separation or total degeneration of the entire labyrinth, no symptoms of vertigo or disturbances of equilibrium occurred unless the brain suffered at the same time) cannot be cited at all in proof; for the destruction by gradual degeneration of the peripheral organ of the so-called static sense produces attacks of vertigo much more rarely, according to universal experience, than the *irritation of the functionally active sense*. Spamer has also proved, experimentally, "that the majority and the most prominent of the motor disturbances occurring after injuries to the canals must be interpreted as symptoms of irritation." In numerous cases the reporter has observed that patients with diseased labyrinths suffered from severe attacks of vertigo at the beginning of the affection, and that these disturbances of equilibrium disappeared completely with the increasing degeneration of the organ.

2. URBANTSCHITSCH, in the present treatise, makes some very interesting communications regarding fatigue of the ear, the localization of the acoustic image, and acoustic after-sensations—questions which have hitherto not received the attention of physiologists which they deserved.

After mentioning previous experiments by Dove¹ and J. J. Müller,² the author first reports those of his investigations which refer to fatigue of the ear. For these he employed two rubber tubes which were inserted into both ears, and the free ends of which were held close together. His sources of sound were large tuning-forks vibrating slowly. To determine the auditory function of each ear, he conducted the diminishing tone of the fork to the two ears, provided each with an ear-tube, in rapid succession;

¹ Dove, Poggendorff's *Annalen*, 1857, Bd. 101, p. 492; 1859, Bd. 107, p. 653.

² J. J. Müller, *Arbeiten a. d. phys. Anstalt zu Leipzig*, mitgeteilt durch Ludwig. Leipzig, 1872, p. 1.

in case the tone faded away more quickly in one ear than in the other, the tube of the better-perceiving ear was removed so far from the source of sound, or the conduction of sound so much weakened by pressure on the tube, that the tone of the tuning-fork became inaudible in both ears at the same time. Then a tuning-fork was struck sharply and held to the free end of one of the tubes, so that that particular ear alone perceived the sound; after ten to fifteen seconds the tuning-fork was quickly dampened by putting a finger to the prongs in such a manner that the tone was just barely audible. As soon as it had completely died away, he rapidly approached the tuning-fork to the tube of the other ear thus far excluded from the test. Thus it was found that the tone of the tuning-fork, which had already become inaudible to the fatigued ear, was still clearly perceptible for several seconds to the non-fatigued ear. In a parallel experiment, in which the rôles of the two ears were reversed, the same phenomenon was apparent. Urbantschitsch had, moreover, made the experiment in such a manner as to rapidly move the greatly dampened tuning-fork, after preceding fatigue of the ear, to and fro between the ends of the two otoscopes. This test-method makes it possible to observe more clearly the difference in the perceptive power of the two ears even before the rapid disappearance of the tone in the fatigued ear.

The fatigue of the ear for the test-tone having been determined by means of the procedure just described, the author endeavored to investigate the behavior of an ear fatigued for one tone, toward another very faint tuning-fork tone.

The experiments at first were conducted only with such individuals as perceived equally well with either ear both a high-tone and a low-tone tuning-fork employed for the test. Urbantschitsch fatigued one ear of such an individual with one of the tuning-fork tones, then removed it and tested immediately afterward the perceptive capacity of both ears with the other very faint tone. The tests yielded no difference of hearing between the right and left ear, but the second tone was perceived as of equal intensity on both sides, and died away at the same time in both ears. This observation, then, is in favor of the assumption that the fatigue of the ear is limited only to that tone or group of tones to which it had been exposed; while the perceptive capacity of the ear for other tones suffers no diminution, at least to an extent demonstrable by the test-methods employed by Urbantschitsch. This

fact becomes very conspicuous if one ear be vigorously acted upon by a high, the other by a low tuning-fork tone; the forks then be quickly dampened, and the moment the respective tone has ceased at either ear, the position of the two tuning-forks be reversed. It then becomes evident that the ear which no longer heard the high tone still plainly perceived the low tone; while again, the other ear, fatigued for the low tone, recognizes the high tone surprisingly well.

Further experiments referred to the *duration of the fatigue*.

To this end, Urbantschitsch allowed the tone of a large tuning-fork to act vigorously on the ear, then quickly dampened it as in the above-described experiments, but kept the fork immovable after it had become inaudible, in order to ascertain if the tone would again become perceptible or not, after a while. It was found that the tone which had been inaudible, indeed reappeared, usually after two to five seconds, was heard for several seconds more, and then died away. In a comparative test of the sound-perception of both ears, the tone returning in the fatigued ear appears as of equal intensity with the other ear, and fades away at the same time on both sides. This shows that an ear fatigued in the above manner recovers completely after the lapse of a few seconds, and perceives again as fully as before the fatigue, or as the other non-fatigued ear.

For the determination of the *localization of the acoustic image*, or, as Urbantschitsch terms it, "*the subjective acoustic field*," he employed a T-shaped conducting tube, the two equally long arms of which were introduced into both auditory-canals, while the third arm served as sound-receiver. The reported results of the experiments show that the differing statements regarding the localization of the subjective acoustic field by Purkyně and S. Thompson, on the one hand (relegating the tone conducted by two receiving telephones into the occiput), and those of Plumaudon,¹ on the other (who places the image into the frontal region), do not contradict each other, but must be referred partly to individual differences, partly to the tones used in the test. For Urbantschitsch found that the various tones were localized in different parts of the head, and that one person tested placed the acoustic field farther forward, another farther back.

The subjective acoustic field in those with normal hearing mostly moved in the medial line of the head, but suffered a lateral

¹ Comp. these ARCHIVES.

displacement whenever one ear was fatigued sooner than the other, and of course toward the non-fatigued side.

The reporter is less inclined to coincide with the remark of the author that *no so-called field of combination* occurs in simultaneous conduction of two tones of different pitch. It appears the author has experimented with tuning-forks only. The reporter is convinced, were the author to extend his experiments to the apparatus for over-tones, that the combination tone will become apparent.

"As regards the *positive acoustic after-images*," in the sense of the optical after-images, nothing was known heretofore but the ones (above-mentioned) resting upon fatigue, *i. e.*, the after-sensations corresponding to the negative optical after-images. We must be careful not to mistake "the memory-images of the senses" (Fechner) for the positive acoustic after-sensations. Urbantschitsch in his experiments found, especially in those with defective, but also in those with normal hearing, that there occur *primary* (*i. e.*, immediately following the preceding objective tone) and *secondary* (succeeding the objective tone after a pause) acoustic after-images.

Generally an after-image persists for from five to ten seconds. It may be mentioned that the positive acoustic after-images can be most easily produced in female and in young male individuals; middle-aged men are but little qualified for the test. In order to prove that they were not "memory-images," the author makes mention of a patient who possessed, in a high degree, the faculty of recalling to mind any musical tone at will. Urbantschitsch first conducted a very high tone into the normal ear of this man. No acoustic after-sensation occurred. He then allowed the tuning-fork to act on the left, very badly hearing ear, and invariably after ten to twenty seconds an exceedingly distinct, quickly evanescent after-sensation ensued.

3. In the introduction to his treatise, DENNERT gives a very clear and lucid historical synopsis of the various methods of analytical tests of hearing, the first instigation to the discovery of which was given by Helmholtz's "*Lehre von den Tonempfindungen*."

The author himself employs for the test, along with Politzer's acoumeter, speech-sounds according to the reporter's method, a series of tuning-forks, namely, capital C, which can be lowered to contra-G by König's disks, also small c, c^I, c^{II}, c^{III}, c^{IV}, c^V,¹ and

¹ The reporter thinks it more advantageous to employ smaller intervals than octaves, and the a^I cannot well be dispensed with, especially for musical patients. The reporter would advise the following forks: C, with eventual lowering to contra-A, also c, g, c^I, a^I, c^{II}, g^{III}, c^V.

of König's steel-rods the g^{VI} , so that he can test within a range of nine octaves, or from 49.5 to 12,000 (single) vibrations. He confirms the experience that if high and low tones are produced under the same conditions and by the application of equal mechanical contrivances, the high tones produce an extraordinarily greater sensation than the low ones; his investigation also proved that the reduced hearing power for *speech* does *not* rise and fall proportionately with the reduced hearing-power for *tones* ("tuning-fork tones" are probably meant.—*Rep.*). He justly ascribes to the coarser disturbances in the perception of tones a great prognostic importance. In the *alterations* of the perception of tones the author distinguishes *three types*: 1. Uniform reduction of the perceptive capacity for all tones. 2. Diminution or extinction of the hearing power from a certain limit toward above or below, uniformly for a whole tone series, so that, for instance, patients who hear the tone series downward as far as contra-G, quite or nearly normally, show an evenly progressing diminution of perception toward the higher and highest tones, and the opposite. In a number of patients who hear the respective tones not as well by air-conduction as by bone-conduction, we may conclude (in connection with the objective condition of the middle ear) that we have to deal mainly with alterations in the dynamic activity of the sound-conducting apparatus. With uniform reduction of both bone- and air-conduction, however, we should assume pathological alterations in the nervous apparatus. 3. Irregular absence of single tones (tone-lacunæ), a more defective condition of perception, points to disease of the labyrinth.

On the whole, the middle series of tones are more rarely affected than the high and the quite low ones.

The author anticipates an elucidation of the function of the *other parts of the labyrinth* from the further advance in the analytical method of testing the hearing; while the present investigations afford to his mind a confirmation of Helmholtz's view in regard to the function of the *cochlea* in the act of hearing.

In conclusion, Dennert gives a most excellent advice as follows: "In the analytical method of testing the hearing, in the combined form by air- and bone-conduction, we have a means for specializing the summary result of the test, and of the capacity of the auditory organ, and thus for localizing pathological processes. Thereby we are also furnished a better direction for therapeutic action. On the one hand, this would be accomplished by our be-

ing in the position, usually after the result of the first examination, to dismiss as incurable, according to the present state of science, with only the necessary dietetic regulation, quite a number of patients—a fact more in consonance with the interest of patients and the dignity of science than their discharge, after long, often painful operative treatment, unimproved or perhaps even worse than before. On the other hand, by the aid of this method, the indication of local treatment, especially by the air-douche as well as by operative interference, may be better formulated.”

4. After Nussbaumer, in 1873,¹ had called attention to the fact that in a few men vivid perceptions of color are associated with tones and chords in such a manner that certain colors and tones belong together, BLEULER and LEHMANN have instituted a series of experiments which confirm and amplify Nussbaumer's statements. In about the eighth part of all the persons experimented upon, it could be demonstrated that on hearing certain sounds or tones, they compulsorily saw fields of varying shape and color. The authors call this phenomenon “*sound-photisms*.” Inversely, *auditory* perceptions may likewise be compulsorily evoked during the act of seeing, but this is more rarely observed. In the same manner, by sensations of smell, taste, and touch, phenomena of association may be produced in the auditory centre. Bright perceptions of light are mostly evoked by high tones, pains, and pointed forms; in like manner, high sound perceptions are produced by bright light. Perceptions of light are most frequently observed on hearing loud vowels, likewise in such a way that the deeper vowels produce rather darker color-perceptions; *e. g.*, the vowel *a* was designated as black 15 times; blue and blue-black, 10 times; red, 15 times; and white, only 6 times; *e*, however, was never perceived as black, but 28 times as yellow, and *i* likewise never black, but as white 37 times in 53 cases. These exact investigations may perhaps in future furnish some valuable contributions to the physiology of the cerebrum.

¹ *Wien. Med. Wochenschr.*, 1873, Nos. 1-3.

SUPPLEMENTARY NOTE TO THE REPORT OF
THE MEETING OF THE AMERICAN
OTOLOGICAL SOCIETY.

SELECTION OF TEST WORDS ACCORDING TO THEIR
LOGOGRAPHIC VALUE.

By CLARENCE J. BLAKE, M.D., BOSTON.

In default of a single adequate test of hearing power, and the necessity, therefore, for the employment of a series of tests, comparative merely, and each including only a portion of the scale of audition, it is, of course, important that the standard of each of these controlling tests should be as nearly as is possible definitely determinable.

Of the various means of testing at our command, the human voice, while of great comparative, is of but little absolute individual value, for the obvious reason that its great variability and the extreme difficulty of ensuring or of measuring any fixed degree of tensivity which may be acceptable as a standard, render it unreliable for purposes of exact investigation. Still, the fact that in the majority of cases of aural disease causing deafness, it is the diminished power of hearing the human voice which has led the patient to seek relief, emphasizes the importance of including the voice in the series of tests which may be used in the first examination, or continued for comparison during the course of treatment. Much, indeed, may be done toward arriving at an idea of the degree of disability in this respect, by a careful use and modulation of the voice in conversation with the patient, especially if words are judiciously chosen and justly articulated.

At the best, however, a test of this sort is but vaguely comparative, and its result must often be accredited rather as an im-

pression of the amount of the disability than as a measure of its degree.

The selection of a series of test words is a step forward in the direction of a determinable standard; though upon whatever basis the selection is made, it leaves much to be desired on the score of accuracy, until more adequate means of determining the sound value of the human voice are discovered that at present seems possible.

With the accurate means at our command for testing the hearing for pitch, by the aid of musical instruments, the selection of test words according to the musical value of the component consonant sounds would seem to be in a measure superfluous, and for this reason I have preferred, instead of using the consonant combinations suggested by Wolf, and others, to make a selection based upon the logographic or force value of the consonant sounds.

The method of making logographic tracings has already been sufficiently described elsewhere.

In utilizing these tracings for the purpose of comparing the force values of the consonant sounds, the tracings, made upon smoked glass or mica, are placed upon paper ruled in squares of millimetres and tenths, and the number of these divisions included within the space bounded by the logographic curve and its base line is taken as the logographic value of the consonant sound traced, expressed in assumed units of force.

The comparison of a large number of tracings goes to show that while the force value of the consonant sounds differs largely in different individuals, and differs also in the same individual at different times, the comparative value of the consonant sounds, one to another, bears a fairly, though by no means absolutely definite ratio. If, therefore, we take the consonant sound which requires the greatest force in its production, which has, in other words, the greatest logographic value, and which would be most readily heard, and express its value as 100, and that of the other consonant sounds accordingly, we have a table from which we may select the materials for a list of test words based upon the intensity rather than upon the pitch of the voice tone produced, and serving, as in cases of chronic middle ear disease for instance, as a measure of the obstruction presented to the passage of the sound. In compounding words from this table, it is better to use monosyllables, and it should, moreover, be kept in mind, that the logo-

graphic value of consonants formed at the back of the mouth is greater in combination with the lower-pitched, and of the front consonants in combination with the higher-pitched vowel sounds. The logographic value of T, for instance, is somewhat greater in the word *tip* than in *top*; and of G, in *got* than in *get*.

T	100	F	35
B	53	K	31
P	58	L	21
D	45	N	11
G	56	M	9
S	40		
Z	63		
C	62		

REMARKS UPON THE CONCLUSIONS OF DR. POLL-
NOW IN HIS PAPER "UPON THE DISEASES
OF THE EAR IN RAILROAD EM-
PLOYÉS."

By S. MOOS, OF HEIDELBERG.

(Translated from the German.)

I STILL hold that it is doubtful if we can agree with the view of the railway officials, which is as follows: "Locomotive engineers and firemen hear sufficiently well, so long as they can follow a conversation carried on in an ordinary tone of voice."

It was exactly this rule that led one of two good physicians into error in my second case, in declaring that the engineer Kraft had normal hearing power, and that in this case he was responsible for the accident, and yet Kraft had only a hearing power of *one metre for a loud tone of voice*. I know very well that the result of my investigations is inconvenient to many railway employés. If the conclusions of Dr. Pollnow are adopted, there will be no need of medical examinations of these men. In the case just cited, the omission of such examinations would imperil the course of justice.

In my fourth case, the hearing distance was only a metre for a whisper, on one side; and, on the other, zero. The employé in question came to me of his own free will, because, in spite of the hand signal, he no longer found himself certain in his work "At a length of a train of twelve carriages, he could not hear the mouth whistle while the train was

being shunted (beim *manovriren*); the hearing power was only sufficient for the length of *four* carriages, with this signal." When we consider that the hand signal, at least in the railways of Baden, is not official, *i. e.*, no employé can be held accountable if he neglects it in the shunting, such facts as have been cited above are of more weight.

Finally, I may add, as regards the experiments of Pollnow with the fulminating signal (torpedoes), that all the employés examined by this test (Nos. 3, 20, and 29 of the table) still had hearing power for a whisper, which none of the employés examined by me possessed.

REPORT OF THE SECTION FOR DISEASES OF THE
EAR AT THE INTERNATIONAL MEDICAL
CONGRESS HELD IN LONDON FROM
AUGUST 3 TO AUGUST 9, 1881.

By H. KNAPP.

The otological section was well attended, there being between 20 and 40 members present at every meeting. The papers were varied and the discussions animated without ever becoming animose. In the "temporary museum" our particular attention was attracted by Prof. A. POLITZER's extensive collection of very elaborate specimens of the different parts of the temporal bone, and numerous large crayon drawings illustrating the clinical features of the diseases of the membrana tympani and other parts of the outer and middle ears. The introductory address of the president, WM. B. DALBY, of London—printed in full in *The Lancet*, August 6th; p. 237,—was elegant and suggestive, touching on the many topics which, of late, have been elucidated by the united work of different nations, or are still under discussion: for instance, the somewhat uncertain and indefinite position of the operations on the membrana tympani, the temporary or permanent loss of hearing primarily due to emotional influences, as the witnessing of the sudden death of a near relative, the fright produced by a cry of fire, the alarm of burglars in the house, the terrible sight of a man cutting his throat, the receipt of great good fortune which had not been anticipated, etc. Such cases, examples of all of which had come to his notice, and a great many other observations, awaited their explanation.

The first subject of discussion: *On the value of operations in which the tympanic membrane is incised*, was introduced by Dr. GUYE, of Amsterdam, who said, that having been requested to

introduce this subject at a very short notice, he would state only his own experience. He classified the cases in which he had incised the *Mt* into four groups.

1st. Cases of simple chronic catarrh, aggravated by cold or some other cause. The results of the incision were generally very good, abridging the duration of the morbid process.

2d. Cases of subacute or chronic catarrh with consistent masses of mucus, which cannot well be removed in any other way. Results of incision excellent.

3d. Cases of chronic catarrh with symptoms of disorder in the inner ear, tinnitus and vertigo. Results in some cases good, in others insignificant.

4th. Cases of paradoxical inflammation of the tympanum with grave symptoms of fever, pain, etc. The characteristic feature of these cases, of which Dr. Guye has seen only two, is that the Eust. tube remains widely open, thus preventing the natural course of the morbid process, which would be a spontaneous perforation of the *Mt*. In both these cases the result of the incision was very good, probably because it opened the way for injections of carbolic acid through the tympanum and tube into the pharynx.

Dr. A. PAQUET, professor of medicine in the Faculty at Lille, read a paper on *A modification of myringectomy for sclerosis of the ear*, of which the following is the official abstract :¹

"The myringectomy which I propose, and which I have found successful, is a combination of that of Weber Liel's, in which there is section of the reflected tendon of the tensor tympani muscle, and of that in which an incision, with or without excision of a portion of the membrane, is practised. The blade of the knife I use is two millimetres in breadth and four in width, bent slightly, like a scythe.

"The procedure is as follows :—A puncture is made $1\frac{1}{2}$ millimetres in front of the hammer, and the membrane is divided obliquely, downward and backward, in such a manner that the lower extremity of the incision is placed halfway between the umbo and the periphery, and at a point where a line drawn vertically downward from the umbo would meet it. This incision divides not only the membrane, but also the reflected tendon of

¹ Those portions of the present report which are put in quotation marks, are copied from the official abstracts which the authors of papers had to send in before the meeting of the Congress, the others are from my own notes.—K.

the tensor muscle, or at least the tensor ligament of Toynbee. A second incision is now made in the posterior segment two millimetres from, and parallel with the manubrium, and then passes forward to meet the lower end of the first incision. By excising a portion of the lower end of the V-shaped curtain thus made, the perforation is rendered durable."

Prof. VOLTOLINI, of Breslau, performs paracentesis of the *Mt* when there are exudations in the tympanic cavity. Such exudations are much more frequent than is commonly supposed. Even if they cannot be recognized when the drum-head is thickened, we may find them against our expectation. The diagnosis is essentially aided by the use of sunlight for which he employs Prandom's mirror.

Dr. LÖWENBERG, of Paris, incises the *Mt* when there is too small a natural opening for the escape of copious secretions of pus.

He thinks that paracentesis for diagnostic purposes, is unjustifiable, but that it is of great value therapeutically. In acute cases the artificial perforation is preferable to the natural, because the former can be followed immediately by antiseptic treatment protecting the parts against infection from outside, which, after the spontaneous perforation, is apt to occur.

Dr. THOMAS BARR, of Glasgow, thinks paracentesis of importance when, by thickening of the drum membrane, a spontaneous rupture is difficult. In accumulations, he performs it when there is distinct bulging and fluctuation, as is frequent in children. In other cases he does not ascribe great value to the operation.

Since Dr. Paquet extends the indications of incision to otitis sicca, Dr. F. M. PIERCE, of Manchester, asks what advantage incisions of the *Mt* can have in sclerosis, where they relieve none of the bad conditions.

PAQUET and others advocate incisions in these cases for the sake of relieving abnormal tension.

Dr. GELLÉ, of Paris, has often made incisions of the *Mt*, but they all closed again.

PAQUET.—We must not make incisions, but excisions of the *Mt*. The more extensive the excisions, the greater the chances for a permanent opening. In practising excision, it is of importance to avoid wounding the labyrinth wall of the tympanic cavity, which requires a good deal of dexterity. He excised the greater part of the tymp. membrane, and never saw inflammation follow. In three of his cases the opening was permanent.

Mr. U. PRITCHARD, of London, confirms the improvement of hearing in cases in which the perforation can be kept open.

Dr. J. PATTERSON-CASSELLS, of Glasgow, also speaks in commendation of paracentesis for relieving tension, but where he performs this operation most frequently is in cases of serous catarrh, with accumulation of fluid in the tymp. cavity. In this way he has cured 95 per cent. of these cases; in 2 per cent. inflammatory reaction followed. The value of intratympanic injections, he says, is a myth, because they do not solve the mucus.

Dr. JONES, of Chicago, advocates paracentesis in acute cases; in chronic, he removes the mucus by injections through the Eust. tubes.

The second subject for discussion: *Morbid growths within the ear, and their treatment*, was introduced by an extensive paper of Dr. J. PATTERSON-CASSELLS.

On the ætiology of aural exostoses, and their removal by a new operation. The author asked permission to read only the conclusions:

"The osseous tumors of the external meatus are of two kinds: the one, named hyperostosis, being a hyperplasia; the other, exostosis, being a new growth. These differ from each other in origin, site, shape, structure, and number.

"Hyperostosis is never seen till the osseous meatus is completely ossified; exostosis appears before the complete ossification of the meatus. Exostosis is found arising from a point near the junction of the osseous canal with its cartilaginous portion; hyperostosis is seen only in the inner or osseous end of the external auditory canal. Hyperostosis is always conical in shape, never pedunculated; in exostosis, on the other hand, there is always a pedicle, and its shape varies. Hyperostosis is of ivory hardness; exostosis, before complete ossification has taken place in the tumor, can be pierced to a varying depth. Hyperostosis is not movable on pressure; exostosis is slightly movable, even when complete ossification has taken place. Hyperostosis is often seen without any other disease of the ear, and if an ear disease exists, there is no causative relation between them; they exist altogether independently, and apart from each other. Exostosis is nearly always complicated with another affection of the ear, past or present. Hyperostosis, therefore, may exist in the meatus with normal hearing. Exostosis, on the other hand, is almost always

attended by a defect in the hearing. The operation for the removal of hyperostosis is only justifiable, when its mechanical presence has been ascertained to be the sole cause of the deafness, or when a coincident ear discharge exists, the escape of which may be hindered or altogether arrested by the presence of the tumor. The commonest cause of deafness in hyperostosis is the presence of débris around the tumors, either cerumen, epidermic masses, or other matters, or the mechanical irritation and inflammation of the tissues that cover the tumors. The hearing is mostly restored on the removal of the débris or inflammation. The operation for the removal of hyperostosis is best effected by a mechanical drill, such as dentists use ; this is the safest method of removal.

"For the operation of the removal of an exostosis a gouge is the best instrument, because the tumor can be removed at one operation, whereas a hyperostosis usually demands several operations, as well as separate sittings, for its complete removal, when this is possible. There may be several hyperostoses in an ear, but hardly ever more than one exostosis. Both classes of tumors may exist together in the same ear."

Then followed a paper of Dr. LAWRENCE TURNBULL, of Philadelphia, of which, in the absence of the author, the Secretary read the official abstract: *Morbid growths of the ear, and their treatment* (with cases), in which were enumerated the different kinds of tumor observed in the three parts of the ear, as well as in the cranial cavity, involving the acoustic and other nerves.

Attention is drawn to "fatty metamorphosis of the organ of Corti, resembling sarcoma of the auditory nerve, as described by Moos, amyloid degeneration of the auditory nerve, as described by Voltolini, and corpora amylacea, found in the semicircular canals of man, and described by Lucae.

"*Treatment.*—Where the growths can be reached, the only successful plan of treatment is the early removal by excision by the knife, preventing danger of hemorrhage by the use of the ligature, clamp-forceps, thermo- or galvano-cautery. Removal of diseased bone by forceps, sharp spoon, revolving knives, or the surgical or dental engine.

"The most important plan of treatment is the removal of all vascular or polypoid growths as soon as they are brought to the notice of the aural surgeon. All puncturing or irritating of the above growths by means of needles, small sharp knives, or caus-

tics, is to be entirely avoided, for, in our experience, all such meddlesome surgery tends to increase and inflame them, and may change an originally benign growth into a malignant one."

A very interesting observation by Prof. A. POLITZER, of Vienna, was, in the absence of the author, communicated by the writer of this report, on *A case of carcinoma of the middle and the inner ear*. The pseudoplasm seemed to have originated in the tympanic cavity. It had grown both outwardly and inwardly, and terminated fatally by its extension into the cranial cavity. The most interesting feature of the observation lay in the fact that the growth had just begun to encroach upon the labyrinth, without yet having destroyed the soft parts. Vertical sections through the cochlea (of which a large drawing and several microscopic specimens were demonstrated by the speaker, and examined with marked attention by the members) showed one convolution almost normal,—only some tumor elements being situated on the upper part of the stria vascularis and in the ductus cochlearis; whereas in a second section the scala tympani was almost completely filled with tumor elements, and in a third both scalæ were invaded by considerable masses of the growth.

Discussion on the tumors of the ear.

Dr. GUYE.—One exostosis may occlude the auditory canal completely; when there are several they always leave a hole.

Dr. LÖWENBERG has seen two exostoses joined by an osseous bridge.

Dr. PIERCE has seen a case where the canal was closed by a single exostosis. Purulent inflammation and cerebral symptoms were present. The exostosis was drilled and the mastoid opened; the exostosis returned.

Dr. GELLÉ spoke of the exostosis of the prehistoric inhabitants of Peru. The tumors were on the anterior and posterior parts of the canal. He found them present in 16 out of 66 skulls.

Dr. KNAPP said that through the kindness of Dr. Cl. J. Blake, who had found them frequently in the Mound Builders of Tennessee, he had seen such skulls in the Peabody Museum of Boston. Exostoses were noticed in about 40 out of 250 skulls examined, and occupied the tympanic part of the canal. There was no symptom of syphilis in the skeletons of the Mound Builders. Virchow, with whom he had lately had the privilege of speaking about this subject, said that those bony excrescences were sup-

posed to have resulted from foreign bodies, which the savages used to put in their ears.

As to the multiple mammiform exostoses, Dr. K. stated that in a low degree of development they were not at all infrequent, but were easily overlooked. Their growth was commonly very slow, and they mostly became stationary after a certain time. He was not quite sure whether they never met so as to occlude the canal completely. He had seen a case where the skin had coalesced, but on incising it, a fine probe could be passed through a central aperture between the crests of the elevations. He had successfully chiselled the opening larger. He had seen complete bony closure, but was unable to tell whether it was produced by multiple exostoses or otherwise.

As to hyperostosis, he thinks that syphilis is one of the principal causes, and relates a case of complete deafness from it, which proved incurable in spite of the greatest care and anti-syphilitic treatment, continued for six months.

Mr. PRITCHARD states that exostoses, according to his observations, are rare in hospital practice, but common in private. He thinks that they chiefly result from gout and rheumatism. He attacked one case with a chisel, but had to desist after an hour. On the use of nitric acid, the tumor became loose and exfoliated.

Dr. JONES has seen an exostosis disappear spontaneously.

Mr. GARDINER BROWN thinks that syphilis and gout, especially the latter, are the chief causes. He uses a conical drill.

Dr. REEVES, of Toronto, says that they are mostly the result of purulent otitis media.

Dr. SAPOLINI, of Milan, remarks that there are soft and hard exostoses; the former sometimes disappear spontaneously.

Dr. GELLÉ mentions that in one case he has seen a polypus originate in a psoriasis patch. Psoriasis of the ear canal is quite frequent.

The third subject for discussion was: *Loss of hearing where the external and middle ears are healthy.*

Dr. GELLÉ, of Paris, read a paper on *Nerve-lesion deafness*, illustrated by cases, of which the reporter regrets having been unable to take notes.

Prof. LUCAE, of Berlin, made some remarks on the *Physical diagnosis in cases of deafness with healthy conditions of the outer and inner ears.*

The remarks were illustrated by demonstrations of Rinne's method of applying the tuning-fork. He began by disproving Mack's theory of the escape of sound through the canal in cranial conduction.

"The usual determination of the condition of the inner ear, by placing a tuning-fork on the cranium, is sufficient. There may be conditions present which cause a pathological increase of the sound-perception.

"The proving of the functional activity is more fully determined by placing a deep fork (C), the vibrations of which have just ceased to be perceived by the acoustic, while placed on the mastoid process, opposite the meatus, and noting if the vibrations not perceived on the mastoid process are perceived in this position. The longer the fork is heard opposite the meatus, after it has ceased to be perceived through the mastoid, the more certainly is a complication in the sound-conducting apparatus excluded. On the contrary, should the note be heard longer from the mastoid process than opposite to the meatus, a disturbance in the sound-conducting apparatus is determined; but in this case there remains the uncertainty as to there being an affection of the inner ear present at the same time. In order to determine this more fully, the use of the tuning-forks (C⁴ and F⁴) are useful, which are heard relatively well, even with a considerable affection of the conducting apparatus, but very feebly with disturbances of the nerve apparatus.

"For an exact determination, the time during which the corresponding fork is heard by the patient and the observer should be compared by means of a chronoscope, the difference of the time in seconds denoting the degree of disturbance."

Dr. STEVENS, of New York, read a paper on *Certain conditions of the eyes as a cause of loss of hearing by reflex irritation*, of which the reporters were unable to take notes.

Dr. KNAPP related a case of one-sided complete and incurable deafness from mumps, that had recently come under his care. The tuning-fork was perceived by bone-conduction only on the healthy side, by air-conduction well, and in puffs on the healthy, feeble and even on the deaf side. The middle ears were quite healthy. Such cases had been very rare in his practice, whereas he had frequently seen epidemic mumps complicated with acute perforative or non-perforative otitis media.

W. B. DALBY stated that he had quite frequently seen one-sided, and sometimes sudden deafness in mumps, and double-sided without any lesion of the middle ear.

Dr. BABER has, like Lucae, found Rinne's experiment useful.

Dr. PIERCE spoke of reflex action from plugs of cerumen and other foreign bodies in the ear.

Dr. KNAPP called attention to the observations of blindness and deafness from large doses of quinine (3 grm. and more, *pro die*), recently published in America (the last numbers of the *Arch. of Ophthalmology*). The deafness is complete, but commonly lasts only a day; the blindness is likewise total, but the recovery is very slow and frequently incomplete. A marked and lasting contraction of the visual field being one of the essential features, Dr. K. tested the hearing with that point in view, but found after the recovery the hearing perfect in all respects: acuteness, perception of high, middle, and low tones, and of timbre. Middle ear and *Mt* were found normal, also during the attack. The excessive pallor of the optic disc, with almost invisible blood-vessels, noticed at the outset of the poisonous effect, and in the grave cases remaining permanent, suggests a similar condition of ischæmia in the cochlea.

This communication gave rise to a lengthy discussion on the effect of quinine on the ear, in which Dalby, Jones, Gellé, and others took part. No one had noticed total deafness ensue from quinine, but it was stated that when taken for a long time, quinine produced hardness of hearing by nervous exhaustion, though the beneficial effect of long-continued use of the drug for noises, vertigo, etc., as recommended by Jacoud, Charcot, and others, was confirmed by Gellé.

The discussions on the official subjects were followed by the presentation of a considerable number of *original papers*, the majority of which excited more or less extensive discussions.

Dr. C. E. FITZGERALD, of Dublin: *On objective noises in the ear*, does not think that they result from the contractions of the tensor tympani, but from the muscles of the pharynx.

LÖWENBERG remarks that Politzer was the first to advance the explanation according to which they were caused by a violent separation of the walls of the tube. L. found that after successful catheterization of the tube these noises were apt to cease.

Concerning other noises, Woakes said that hydrobromic acid gave relief only in pulsating tinnitus.

Dr. H. KNAPP, of New York : *The cotton pellet as an artificial drum-head.* Its acoustic efficacy was found demonstrable in more patients than he formerly thought, and in some it was so great and lasting as to yield the most gratifying results. Its protective effect consisted in the protection of the middle ear from atmospheric influences. As one of its curative effects, he stated that wicks of good absorbent cotton acted as excellent drainage-tubes in chronic otorrhœa. The mechanism of its action was different in different cases. In some, in which the tensor tympani exerted too strong an inward pressure, it counteracted that effect by pressure on the short process and other parts of the ossicles situated above their axis of rotation ; in others, where the malleo-incudal and other joints were loosened, it acted by pressure on the handle and those parts which were situated below the axis of rotation. Politzer (communication by letter) had been able to confirm these views by experiments on patients. A most important action of the cotton pellet was to regulate the moisture in the drum cavity : on the one hand (in profuse otorrhœa), checking over-secretion ; on the other (in sclerosis), stimulating secretion, thus keeping the parts in the best conditions of vibratility. Besides the cotton pellet, he, like C. H. Burnett, had found Blake's little paper discs to afford great aid to hearing in certain cases of old perforation.

The artificial drum-head was discussed at considerable length, and mostly commendatorily, by the chairman and many members present.

E. CUMBERBATCH, of London, has seen cases in which the hearing, improved at first, decreased in later years. He had to employ greater pressure.

CZARDA, of Prag, uses and recommends a silk artificial drum-head.

McMILLAN uses cotton first, then discs of wood. He also thinks that the pressure has to be increased later.

CASSELS has likewise used the artificial *Mt* with advantage for years. He did not find that it lost its efficacy ; on the contrary, it improved the natural hearing gradually, so that the patients could dispense with the artificial aid.

Dr. A. GARDINER BROWN, of London : *The sense of touch as a standard of comparison for hearing-power.*

"For examining auditory perceptivity the tuning-fork is to be preferred to the watch. The Middle-C fork (= 256 v.s.) is an excellent standard of pitch, corresponding as it does with about the middle of the compass of the human voice as used in conversation. When the 'field of audition' (Knapp) is being determined, higher and lower pitches are made use of.

"Hitherto the best way of employing a tuning-fork has been to strike it with a measured blow to insure uniform amplitude of its vibrations, instantly applying it to the patient's head and noting the *duration* of his hearing-power (Magnus).

"The author has now conceived the idea that the point in the lessening amplitude of the vibrations corresponding with the moment of their loss to the sense of touch in the thumb and finger of the examiner, forms an excellent and convenient standard of reference for the auditory perceptivity of the patient.

"Hearing-power, falling short of this point, the author has designated as *minus*, that exceeding it as *plus*, time being reckoned in half seconds (to save fractions); this may be done by means of a stop-watch, but the author prefers simply *counting* in half-seconds, easily and accurately done after a little practice; or the time may be estimated by a tubular sand-glass, which he has had constructed for the purpose.

"The most suitable points for ordinary examination are over the mastoid for bone-conductivity, and at the focus of the concha for aerial sound-waves.

"Example of Use of Middle-C Tuning-fork."

"Case of P. S., æt. 46, simple middle-ear catarrh (left side).

	Right Ear.	Left Ear.	Left Ear (after Politzer inflation).
Over Mastoid	. + 9	+ 13	+ 13
Focus of Concha	. + 17	- 13	- 5 "

Dr. GELLÉ read a paper on the *Accommodation of the ear*, which he, of course, thinks to be affected by the muscles of the ear. The reporter's notes are too insufficient to do justice to Dr. Gellé's views on a subject which has, rather unsuccessfully, been touched upon by several others.

Dr. E. WOAKES, of London, summarizes what he communicated in a paper read before the Brit. Med. Ass., at Cork, in 1879 (pub-

lished also in the *Amer. Jour. of Otology*, Oct., 1879), and "in the present paper he contributes his further experience of the disease, adding thereto some illustrative cases." As the essential features of paretic deafness—"neurotic lesions of a paretic character of the muscular apparatus of the middle ear, including the tubes,"—he mentions absence of changes in the *Mt* and of tinnitus and non-progressive impairment of hearing.

Dr. F. M. PIERCE, senior surgeon to the Institution for Diseases of the Ear, Manchester, contributed an important paper on *The action of syphilis on the ear*.

"The effects of congenital and acquired syphilis on the ear are less observed than its effects on the eye, teeth, skin, etc. Syphilitic ear affections are analogous to corneo-iritis and amaurosis.

"Primary sores of the ear are very rare; secondary squamous, pustular, and papular eruptions are common. (Cases quoted.)

"The evidence of syphilis attacking the middle ear is mainly of a catarrhal character, with a marked prevalence of anomalous auditory-nerve symptoms, and, in adults, these symptoms are suggestive of acquired or congenital syphilis as a predisposing cause.

"(Forty cases of acquired syphilis affecting the ear referred to.)

"Inherited syphilis is manifested from 11 to 18 years as average; most frequent in females, as 4 to 1.

"Access of deafness gradual but rapid; in from three weeks to one year. About period of puberty in females, rather later in males.

"The membrana tympani dull, pearly opacity, collapsed, the light spot large and dull, and the manubrium red, flat, and retracted. The meatus dry and polished. The nasal passage swollen, and seat of chronic thickening and discharge.

"The deafness generally preceded by specific chronic interstitial keratitis, recovery from which is signal for accession of extreme deafness of a very intractable character. The early decay of the characteristic teeth of hereditary syphilis produces frequent earache.

"(The effects of congenital syphilis of the ear have been noticed in thirty-five cases.)

"As a summary of the characteristics of acquired and congenital syphilis affecting the ear we see:—

"1. Extreme degree of deafness manifested early in the progress of the disease.

"2. Rapidity of progress and absence of pain.

"3. Early and extreme loss of hearing for the tuning-fork over the vertex.

"4. Frequent imperviousness of both Eustachian tubes.

"5. Constancy of the tinnitus, of a hissing kind.

"6. Frequency of simultaneous inner-ear symptoms.

"7. Improvement of pre- or co-existing eye affection.

"8. More decided affection of the naso-pharynx than in catarrhal ear disease.

"9. Less complete recovery than in simple catarrh.

"Intolerance of sound, like that of light in syphilitic eye affections, is not a noticeable feature in syphilitic ear affections."

Dr. THOMAS BARR, of Glasgow, read a paper on *Caseous accumulations in the middle ear, regarded as a probable cause of miliary tubercle*.

"Pathologists generally agree that acute tuberculosis depends on a virus, and that this virus often consists of caseated products of inflammation accumulated in some part of the body.

"The peculiar structure of the middle ear favors the retention, drying, and ultimate caseation of the catarrhal products formed therein.

"Facilities for the absorption of the caseated matter are afforded, first by the blood-vessels of the middle ear, and secondly by the lymphatics; absorption by the former leading to general tuberculosis, and absorption by the latter to local tuberculosis and especially to tubercular meningitis.

"There is special danger of tubercular self-infection when such caseous collections exist in persons of scrofulous tendencies or at the tubercular age. There is a stage in the purulent process when there is greater danger of pyæmic phenomena; but there is also a stage when the tendency to tubercular self-infection is greatest, and that is after the discharge from the ear has spontaneously ceased, or has been cured by treatment.

"The chief objection offered by the opponents of the theory of self-infection of tubercle by the absorption of caseous collections is, that cases of tuberculosis are seen where no caseous virus can be found in any part of the body. May it not be that the search, in some at least of these cases, proves unsuccessful just because no inspection of the ear is made?

"It is urged, in conclusion, that when a case of tubercular disease, and especially of tubercular meningitis, comes before the physician,

or the pathological anatomist, attention should be given to the condition of the middle ear."

According to the reporter's notes, Dr. Barr came to the conclusion that the ear disease in phthisis was a coincidence or a symptom of the general tuberculosis, not its origin. This statement seems to be so much at variance with the official abstract of the paper, as to make the reporter suspect that the bias of his own mind has led his pencil in a wrong direction.

Dr. ARTHUR KINSEY read an elaborate paper on the *Prevention of dumbness in those cases where it follows loss of hearing*. He dwelt on the advantages of teaching the deaf how to speak. Very extensive statistics on deaf-mutism from different points of view are given, of which the following are of particular interest: Deaf-mutism is found in 1 case out of 19 marriages when both parents were deaf-mute, in 1 case out of 130 of one parent only being deaf-mute, in 1 case out of 6,000 of both parents hearing well.

Dr. BOUCHERON communicated the case of a girl, æt. 2 years, who had meningitis and, four weeks later, scarlet fever. Her hearing was impaired, and she could not walk. A few Politzer inflations restored both the hearing and the walking. B. thinks that in this case increased pressure on the inner ear was present, and makes some remarks upon the tension in the ear, basing his determination upon the height of pressure in different parts of the vascular system.

Dr. GARDINER BROWN made some remarks on the physiology of the auricle, stating that the auricle is a resonator of sound, and that the different muscles sharpen different sounds.

Dr. LÖWENBERG, of Paris, read a paper, in which he dwelt on the *Importance of examining the nasal passages*, which should be done as a routine matter in every case of ear disease—*anterior rhinoscopy*. He dilates the nostrils with a bivalve speculum, throws light in by a forehead-mirror, and then introduces the E. catheter. In this way he overcomes obstacles which otherwise would be insuperable.